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A Systematic Study of Genus *Porphyra* found on the Japanese Coasts.

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(Abstracted from the original report in Japanese).

Porphyra, one of the most important marine products of Japan, has been studied in our country mostly morphologically, physiologically or oecologically but systematically very scantily. The systematic study of the genus *Porphyra* in Japanese waters dates back to 1897 when Kjellman published his paper on "Japanska Arter af Slägtet Porphyra," and was taken up by Yendo and others from time to time. Thus, twelve species have been reported from the Japanese coasts, but this number can not be said to include all the Japanese species, because a profound investigation of the plants on Japanese coasts has not yet been made.

However, the present writer has scrutinized the reports of Kjellman, Yendo and other authors, and he enumerates six new Japanese species and three new formae and mentions three known species which are new to Japan.

The diagnosis of the species has hitherto been given mostly on the external appearances (outward shapes), but not so much on their microscopical characters. The external characters, namely, the shape and size, the basal form and the colour of the frond are generally exceedingly variable. Therefore, they seem to be of small value from a systematic point of view. These external characters show in some species very slight individual differences but in other remarkable fluctuations. As to the microscopic characteristics, namely, the structure of the marginal region, the shape, size and the arrangement of the vegetative cells, the form of the basal cells which emit a hyphal thread (rhizoidal projection), the thickness of the frond, and distromatic or monostro-

matic nature of the frond, the individuals in any species do not seem to differ so much from each other. It follows, therefore, that the microscopic characteristics are often of much importance in the diagnosis of sterile frond of the species.

The reproductive cell is derived from ordinary vegetative cell, and it gives rise each to a single mother-cell of antheridium or sporocarp. The manner in which antheridia and sporocarps are divided is fairly the same in any species. Therefore almost the same number of reproductive bodies are formed in each antheridium or sporocarp of a species. The number of reproductive bodies formed in a mother-reproductive-cell is readily calculated by the aid of the Hus's formula.*

The division of antheridia and sporocarps, usually begins with transverse division parallel to the surface of the frond, and is followed by a cruciate division perpendicular to the surface of the frond. And rarely in some species the division takes place reversely. Thus a mother-reproductive-cell generally undergoes first a parallel or cruciate division and then a cruciate or parallel division in each of the segments alternately. The above-mentioned rule does not hold true in some cases but the division takes place invariably in a symmetrical manner.

The method of the reproductive division is of the greatest value diagnostically, because it is almost constant in any species.

In the present paper, the Japanese species are classified according to the nature of the reproductive organs and to the other somewhat invariable, microscopical characteristics.

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* Hus: An Account of the Species of Porphyra found on the Pacific Coast of North America, 1902 p. 191.

A Review of Triglidae, a Family of Mail-Cheeked Fishes, found in the Waters around Japan.[1]

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(Received October 31st, 1932.)

In this paper is given a review of the fishes of the family of Triglidae found to inhabit the waters around Japan. The material are in the museums of the Zoological Laboratory, Imperial Fisheries Institute, Tokyo, and of the Fishery Institute, Faculty of Agriculture, Tokyo Imperial University, and also in the Fisheries Experimental Station at Huzan, Tyôsen. The specimens are referable to three genera, and 17 species. Of 17 species, six are new to science and one is furnished herein with a new name. Besides, two more species were reported to occur in the Japanese waters but no specimens have come under our examination. The original description of each is slightly abridged and printed in the present report. The authors are greatly indebted to Professor A. Terao, under whose supervision the present study was undertaken, and to Dr. S. Tanaka, Dr. Y. Wakiya, and Mr. K. Uchida, who all helped them in various ways. The junior author, to whom the first six species were allotted to work with, wishes to return herewith his hearty thanks to Professor I. Amemiya and to Dr. M. Ishikawa, of the Tokyo Imperial University for their kind direction during the course of his study.

FAMILY TRIGLIDAE (pars) Kaup.

Triglidae (pars), Kaup, 1858, p. 329.
Triglidae, Jordan & Richardson, 1908, p. 649.

Body covered with scales or bony plates. Head bony externally, cuirassed with rough, bony plates all over, some of which armed with spines; eyes high, at top of head; teeth very small, in villiform bands on jaws, and usually on vomer and palatines; gills four, a large slit behind the last; pseudobranchiae present; gill-rakers various. Ventral fin thoracic, their rays usually I, 5.

(1) Contributions from the Zoological Laboratory, Imperial Fisheries Institute, Tokyo (No. 28), and from the Fishery Institute, Faculty of Agriculture, Tokyo Imperial University.

Dorsals two, soft dorsal and anal resemble each other; anal without spines or the first ray in the form of spine; margin of caudal slightly emarginate; pectoral long, with three lower rays detached, forming feelers. Air bladder present.

This family shows close resemblance to Hoplichthidae in many points, especially in having three detached pectoral rays, and bony naked head.

Diagnostically this family may be divided into two groups: one with armature along the lateral line, and the other without any such.

It may be mentioned that the three genera of this family found in the Japanese waters are all referable to the second group.

Key to Genera of Triglidae.

a. Scales cycloid, small, more than 65 along lateral line.
   b. A row of low spinous shields on bases of both dorsals; nasal processes roundish; soft dorsal and anal long, D. IX–16, A. 15; anal spineless; vomerine teeth present ... ... *Chelidonichthys.*
   bb. A row of bony shields along the base of spinous dorsal only, or if present on soft dorsal very rudimentary; nasal prominences sharp; soft dorsal and anal short, D. VIII–16, A. I–11; first ray of anal becomes spine; vomerine teeth wanting... ... ... *Pterygotrigla.*
aa. Scales ctenoid, large, about 50 to 65 in number; vomerine teeth usually present (in two species absent); palatines usually toothless (in one species present); a row of sharp spinous bucklers along bases of both spinous and soft dorsals ... ... *Lepidotrigla.*

Genus *Chelidonichthys* Kaup.

Chelidonichthys Kaup, 1873, p. 87; Jordan & Richardson, 1908, p. 655.

Type:—*Chelidonichthys hirundo* (Bloch).

Scales cycloid, small, no bony shields along lateral line; bases of both dorsal fins with a series of low pungent scutes; opercular spine small; each rostral prominence provided with an axial spines and several small accessory spines; no teeth on palatines; anal spine wanting, both dorsal and anal long, D. IX–15; A. 15 or 16.

This genus differs from *Pterygotrigla* in having the conspicuous scutes along the bases of both dorsal fins, several accesory spines on the rostral prominences, and no anal spine. From *Lepidotrigla* this genus is distinctly separable, amongst others, by having smaller cycloid scales.

This widely distributed genus is represented in the Japanese waters by

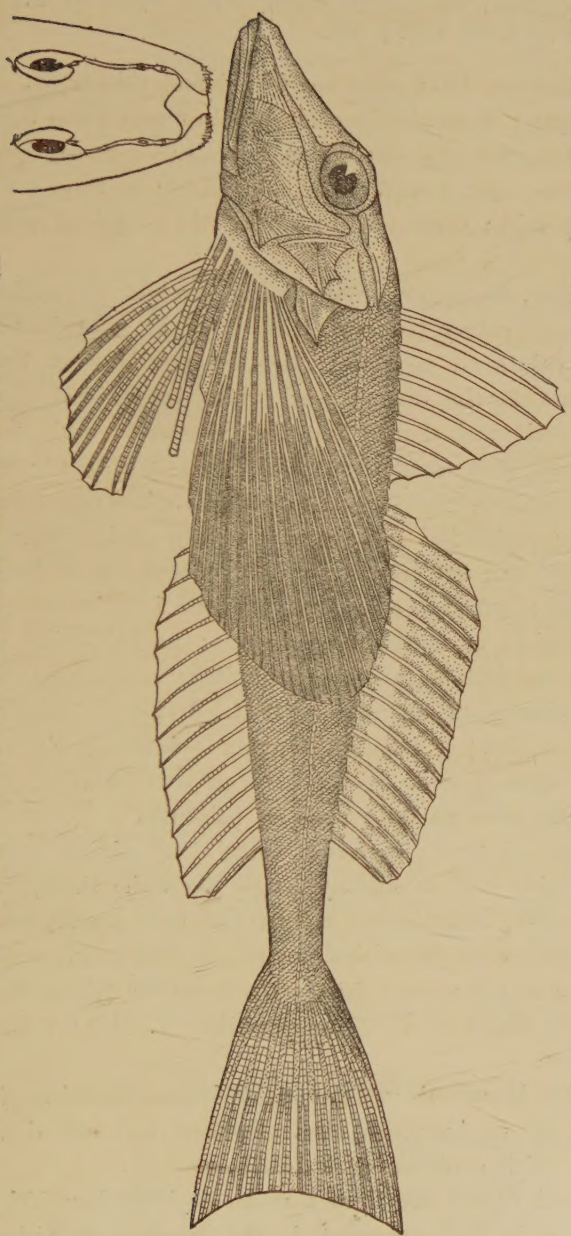


Fig. 1. *Chelidonichthys kumu* (Lesson and Garnot). ×$\frac{2}{3}$. (Matsubara del.)

two species which are distinguishable from each other as given in the following key.

Key to Species of *Chelidonichthys.*

a. Scales numerous, about 180 on lateral line; head small, 3.4 in body; pectoral comparatively short, extends to the ninth anal ray ....*kumu*, 1.

aa. Scales not numerous, about 65 on lateral line; head long, 2.5 in body; pectoral very long, extends to the base of the last anal ray..... .....*ischyrus*, 2.

1. *Chelidonichthys kumu* (Lesson and Garnot)

Japanese Name: Hôbô.

Trigla kumu Lesson & Garnot, 1830, p. 214, pl. XIX; Cuvier & Valenciennes, 1829, p. 50 (advance printing of Lesson & Garnot); Jenyns, 1842, p. 27; Temminck & Schlegel, 1843, p. 37, pl. XIV A; Bleeker, 1860, p. 204; Nystöm, 1887, p. 21; Steindachner & Döderlein, 1887, p. 265.

Trigla spinosa McClelland, 1844, p. 396, pl. XXII, Fig. 2; Günther, 1860, p. 204; Richardson, 1846, p. 218.

Trigla pictipinnis Kaup, 1873, p. 87.

Trigla kumu dorosomaculata Steindachner, 1876, p. 168.
Chelidonichthys kumu Jordan & Richardson, 1908, p. 656; Franz, 1910, p. 79, Taf. II, Fig. 2; Jordan & Hubbs, 1925, p. 288; Schmidt, 1931, p. 120.

D. IX–16; A. 16; scales ca. 180; pores ca. 65; dorsal shields 24.

Head 3.39 in body length; depth 5.26; orbit 4.11 in head; snout 2.36; maxillary 2.31; interorbital space 6.25; first dorsal spine 1.64; second dorsal spine 1.55; third dorsal spine 1.75; fourth dorsal spine 2.04; pectoral 0.69; longest detached pectoral ray 1.31; ventral 1.16; caudal 1.13; depth of caudal peduncle 5.71.

Body elongate; snout long, its upper profile nearly straight or slightly concave; anterior edge of snout rather truncate, with a slight emargination, armed with several small spines on each side, the distance between their apices of longest spines equal to the diameter of orbit; interorbital space narrow, shallowly concave, and much shorter than the diameter of orbit, 1.52 in it; eye small, much shorter than snout, about 1.74 in length of snout; and slightly shorter than depth of suborbital stay; supraorbital spines two, strong and pungent; a rudimentary postorbital spine present; very shallow furrow above the posterior margin of eye, not crossing medially above top of head; parietal ridges very indistinct; humeral spine short, about 1.14 in eye and scarcely extending to the vertical of fourth dorsal spine; nuchal spine not reaching to the insertion of the first dorsal spine; maxillary extending to the anterior margin of orbit; gill-rakers on first arch 1+8 (2+12 including rudimentary rakers), long and slender, but not sharply pointed at tip, the second on the lower limb longest, 3.26 in orbit; teeth on jaws broad, upper broader than lower; vomerine teeth present; none on palatines.

Dorsal spines feeble, not pungent; posterior margin of spinous dorsal nearly straight, the second spine longest, slightly longer than the third, first and third subequal; no serration along dorsal spine; the first dorsal, when depressed, reaches to the insertion of the second dorsal; pectoral long, extending to the base of the ninth anal ray; upper detached pectoral ray falling short of tip of ventral by a distace about equal to the diameter of orbit; ventral reaching to the first anal ray.

Color in formalin bluish brown above, and paler below, markings indistinct. Inner side of pectoral fin brownish blue. Spinous and soft dorsal mottled with dark. Caudal with a diffuse dark blotch.

Foregoing description and Fig. 1 are from a male specimen from Tokyo Bay, measuring 240 mm. long in total, deposited in the museum of Fishery Institue, Faculty of Agriculture, Tokyo Imperial University.

Individual color variations are remarkable. In full grown specimens, dark brownish polygonal spots on the ground of whitish narrow area scatter all over the upper part of the body; they often condense to form cloud-like irregular markings; in young specimens (about 130 mm. long in total) the markings more distinct and darker, so they are often called "Kuro-Hôbô (Black Gurnards)" as Steindachner & Döderlein (1887) described; the markings are rather deffinitely located, two under the spinous dorsal, two under soft dorsal, one under caudal peduncle.

In life the polygonal spots are brick-red, their bordering areas are yellowish red; inner side of pectoral greenish blue, with many lustrous pale blue spots and often a large dark blotch on the lower half of it. Number of pectoral spots are indefinite; it varies from 9 to 19, average 14.1, in 16 specimens from the Tokyo fish-market. Even in one and the same specimen the number differs on either side of the body as given in the following table.

Specimen No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total	Average
Right side	18	17	19	17	19	18	12	9	13	19	16	16	13	16	13	12	247	15.4
Left side	17	13	17	13	17	14	10	16	10	14	12	13	14	12	15	14	221	13.8
Total	35	30	36	30	36	32	22	25	23	33	28	29	27	28	28	26	468	29.2

It is worth mentioning that all the specimens at our disposal have "bluish white spots extending over nearly all the lower half of pectoral fin," a character which was used by Günther (1860) to distinguish *spinosa* from *kumu*. Yet we quite agree with Jordan and Richardson to regard the differences of the two too slight to warrant their separation into two species.

Numerous specimens from Tateyama (Prov. Bôsyû), Tokyo Bay, and Huzan (Tyôsen).

Habitat.—From New Zealand to Tyôsi (Prov. Hitati).

2. *Chelidonichthys ischyrus* Jordan and Thompson.

New Japanese Name: Seppari-hôbô.

Chelidonichthys ischyrus Jordan & Thompson, 1914, p. 282. pl. XXXV, Fig. 1.

No specimen has come under our examination. The following is an abridged account of Jordan and Thompson's original description.

Head 2.5 in body length to base of caudal; depth 3.66; eye 3.66 in head; snout 2.166; interorbital space two-thirds of eye; dorsal rays X–16 (last spine rudimentary); anal rays 15; scales 67 in lateral line, 8/5 in transverse series; gill-rakers 1+10.

Body subcylindrical, deep, and relatively shorter than *Chelidonichthys kumu;* snout with two low lobes, each with four very short spines or serrations; maxillary reaching to the anterior border of orbit. Two prominent opercular spines, and one blunt postocular present; a prominent transverse furrow behind the latter. Nuchal region rough.

Dorsal inserted between tips of nuchal spines; third spine 2 in head; third ray 2.66; first anal ray 3.33 in head; pectoral 1.9 in body length, reaching to base of last anal ray; ventral extending to fifth anal ray; upper pectoral appendage 3.33 in body.

Scales minute, imbricate, but partially imbedded, those of lateral line slightly enlarged; shields along dorsals 25 in number, thier edges smooth throughout, spinous projections well-marked and sharp.

Color of alcoholic specimens dark, without silvery reflections; an indefinite dark space between orbit and corner of mouth, also on lower edge of opercle; two dark spots below spinous dorsal opposite third and tenth scutes and one on lateral line, one opposite to sixteenth dorsal scute, and at end of dorsal, an indefinite one below each on lateral line. Spinous dorsal black on distal half; soft dorsal colorless; pectoral black inside; ventrals tipped with dark; caudal dusky at tip; anal clear.

This species differs from *Chelidonichthys kumu* in its larger eye, larger scales, larger head, and extent of pectoral. Its scales are much smaller than those of *Lepidotrigla.* From *L. japonica,* which it resembles, it may be easily distinguished by the cycloid scales, the lesser depth of the postocular furrow, and shorter nasal processes.

Described from a specimen 150 mm long in total from Sagami Bay.

Genus *Pterygotrigla* Waite.

Hoplonotus Guichenot, 1866 (nec Blanchard, 1851).
Pterygotrigla Waite, 1899, p. 108.
Otohime Jordan and Starks, 1907, p. 13.

Type:—*Pterygotrigla polyommata* Richardson.

Scales cycloid, very small; no bony shields along lateral line; back with blunt shields along base of spinous dorsal; base of soft dorsal unarmed, if

Fig. 2. *Pterygotrigla hemisticta* (Temminck and Schlegel). ×$\frac{4}{5}$. (Hiyama del.)

armed, very feebly; opercular spine long; dorsal rays VIII–10; anal 11; a distinct anal spine; spines of head various, palatines not toothed.

This genus differs from *Chelidonichthys* in having a more rudimentary dorsal shields, mostly along spinous dorsal only, and in having soft dorsal and anal shorter.

The types of this genus inhabit warmer seas; the specimens from the Japanese seas are referable to two species, one of which is new to science.

Key to Species of *Pterygotrigla.*

a. Nuchal spine short, about one third of diameter of eye; humeral spine short, about half of diameter of eye; opercular spine long, 1.5 times of eye; maxillary well extends to the vertical of anterior margin of orbit; depth of suborbital shorter than eye... ..... *hemisticta*, 3.

aa. Nuchal spine long, about 1.2 times of eye; humeral spine long, about 1.4 times of eye; opercular spine rudimentary; nasal spine triangular; maxillary not extending to front of orbit; depth of suborbital longer than eye..... .....*ryûkyûensis*, sp. nov. 4.

Fig. 3. *Pterygotrigla hemisticta* (Temminck and Schlegel). ×$\frac{4}{5}$. (Hiyama del.)

3. *Pterygotrigla hemisticta* (Temminck and Schlegel).

Jap. Name: Sokohôbô.

Trigla hemisticta Temminck and Schlegel, 1850, p. 36, pl. XIV, Fig. 3 and 4, pl. XIV B; Richardson, 1846, p. 218; Günther, 1860, p. 201; Nyström, 1887, p. 21; Day, 1889, p. 211.

Otohime hemisticta, Jordan and Starks, 1907, p. 132, with figure; Jordan and Richardson, 1908, p. 658; Franz, 1910, p. 80.

Pterygotrigla hemisticta, Jordan, Tanaka, and Snyder, 1913, p. 289, Fig. 239; Schmidt, 1931, p. 120.

D. VIII, 10; A. I–10; scales ca. 100; lateral pores 60; dorsal shields 10+0; gill rakers 2+11; branchial rays 7.

Head 2.7 in body length; depth 4.4; orbit 3.3 in head; snout 2.7; maxillary 2.25; interorbital space 2.9; first dorsal spine 3.7; second dorsal spine 2.5; third dorsal spine 2.0; fourth dorsal spine 2.0; pectoral 1.1; longest detached pectoral ray 1.2; ventral 1.8; caudal 1.4.

Snout rather short, its upper profile slightly concave; anterior edge of snout nearly straight, processes in two blade-like spines projecting

forward, distance between their apices about equal to diameter of eye; interorbital space slightly concave, longer than eye, 1.16 times of it; eye small, its diameter shorter than snout, 1.22 in it, much longer than depth of suborbital stay, 1.5 times of it; postorbital ridge present; supraorbital spineless; humeral spine very short, shorter than diameter of eye, about half of it, extending to the vertical of third dorsal spine; nuchal spine very short, about 1/3 of the diameter of eye, scarcely extending to the vertical of first dorsal spine; opercular spine very long, much longer than eye, 1.5 times of it, reaches to the point vertical of the fifth dorsal spine; maxillary extending to below anterior margine of eye; gill rakers on first arch 2+11, short, fourth raker longest, 6.7 in orbit; teeth on jaws in villiform bands; vomerine ridge toothless; no teeth on palatines.

Dorsal spine rather feeble, slightly pungent; second and third spines bluntly serrated; third or fourth spine longest; the spinous dorsal when depressed reaches to the insertion of soft dorsal; pectoral long, reaches to the third anal ray, upper free pectoral ray long, extends further than tip of ventral about 3/5 of diameter of eye, and reaches to the initial of anal; ventral falling short of initial of anal by a distance about half diameter of eye.

Color in formalin white, dotted by small dark brown spots which are scattered on upper half of the body. A large black blotch on the posterior part of the spinous dorsal; a series of small black spots on the middle of soft dorsal. Anal without pigment. Pectoral black, having margin of white area, and five white spots in one series on the inner part of it.

Described from a specimen 209 mm long in total, from Nagasaki, deposited in the museum of Fishery Institute, Faculty of Agriculture, Tokyo Imperial University.

Four specimens were got from Nagasaki and Enosima (Sagami Bay).

Habitat.—From Canton to Misaki.

Pterygotrigla ryûkyûensis, sp. nov.

New Japanese Name: Ryûkyû-sokohôbô.

D. VIII–12; A. I–11; scales ca. 110; pores on lateral line 58; dorsal shields 8+11.

Head 2.7 in body length; depth 4.8; orbit 3.5 in head; snout 2.1; maxillary 3.0; interorbital space 3.0; first dorsal spine 4.0; second dorsal

Fig. 4. *Pterygotrigla ryukyuensis*, sp. nov. $\times\frac{2}{3}$. (Hiyama del.)

spine 3.0; third dprsal spine 2.3; fourth dorsal spine 2.8; pectoral 1.2; its longest detached ray 1.3; ventral 1.8; caudal 1.4.

Snout nearly straight at anterior edge; nasal processes large, triangular in outline, distance between their apices rather longer than diameter of eye, 1.1 times of it; interorbital space shallowly concave, wider than eye, 1.17 times of it; orbit much shorter than snout, 1.7 in it, shorter than depth of suborbital stay, 1.15 in it; postorbital, supraorbital spineless; humeral spine very long, much longer than eye, 1.4 times of it, and reaches to the vertical of fifth dorsal spine; nuchal spine very long and stout, much longer than eye, about 1.2 times of it, reaches to the fourth dorsal spine; opercular spine very short, appears only as a ridge; maxillary extending to first one-third of the distance between nasal apices and front border of eye; gill rakers 1+10, short, second or third raker longest, about 7.7 in eye; branchial rays 6; teeth on jaws in very narrow bands, narrower than *hemisticta;* vomer toothless; no teeth on palatine.

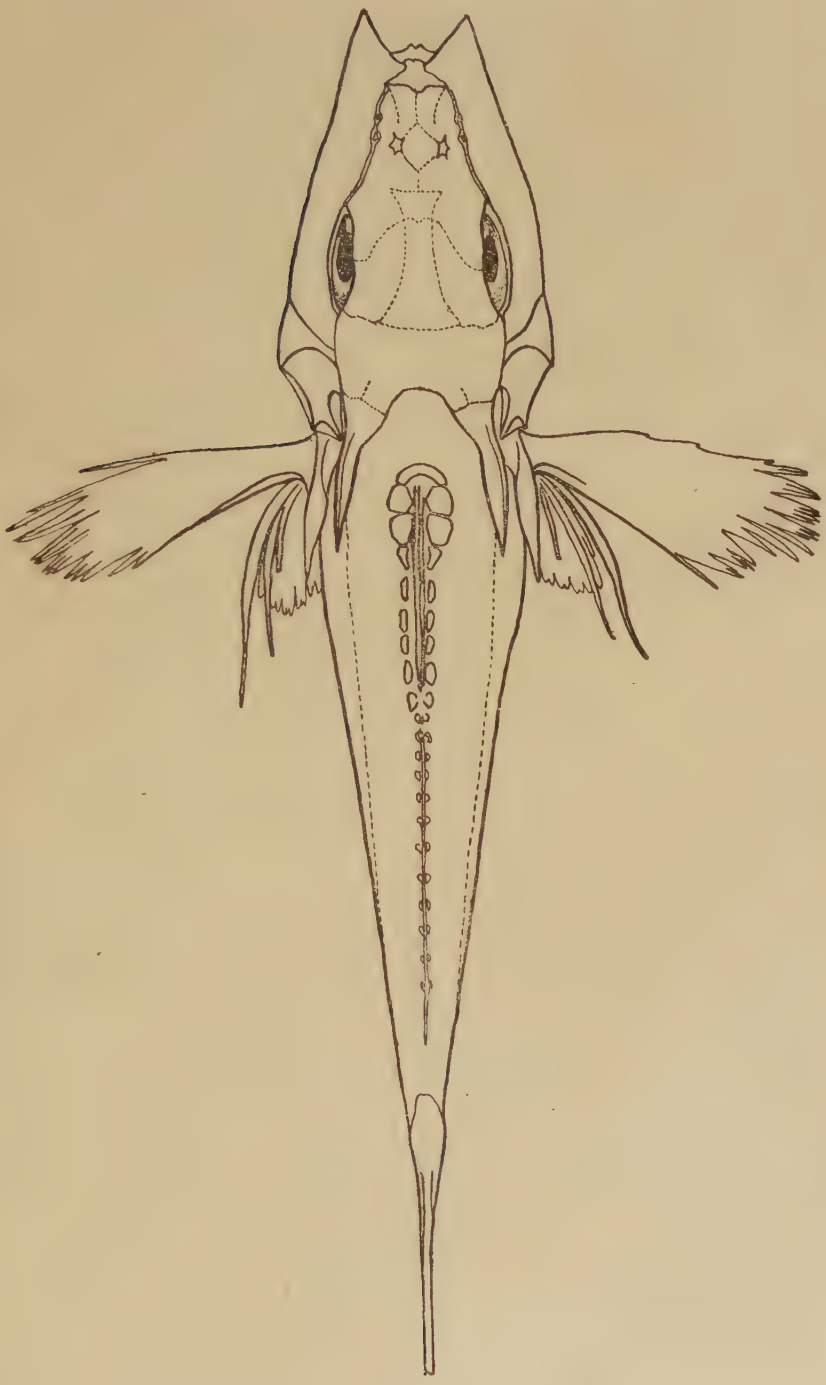


Fig. 5. *Pterygotrigla ryukyuensis*, sp. nov. ×$\frac{3}{4}$. (Hiyama del.)

Dorsal spine rather feeble, scarcely pungent; second and third very feebly serrated; third spine longest; the spinous dorsal when depressed does not reach to initial of soft dorsal; pectoral long, reaching to the base of the fourth anal ray; upper detached pectoral ray long, reaches to the base of second anal ray, extends farther than tip of ventral by about 3/5 of the diameter of eye; ventral short, reaching short of initial of anal by a distance about half of the diameter of orbit.

Color in formalin white (as the specimen is rather old).

Holotype is a male specimen from Ryûkyû Is. measuring 260 mm. long in total, deposited in the museum of Fishery Institue, Faculty of Agriculture, Tokyo Imperial University.

The present species differs from *P. hemisticta* in having much longer nuchal, humeral spines, a much shorter opercular spine, a triangular nasal spine, a higher suborbital area, and a shorter maxillary. Characteristically this species is furnished with a series of very rudimentary shields along the base of soft dorsal.

No other specimen than the holotype was obtained.

Habitat.—Ryûkyû Is.

Genus *Lepidotrigla* Günther.

Lepidotrigla (pars) Günther, 1860, p. 196.
Lepidotrigla, Jordan and Richardson, 1908, p. 649.

Type:—*Lepidotrigla aspera* (Rondel).

Scales ctenoid, large, less than 65 in number; no bony shields along lateral line; a row of pungent shields along bases of both spinous and soft dorsals on each side; cranial spines distinct; teeth on jaws in villiform bands; palatine usually toothless, except *L. japonica;* vomerine teeth usually present, except *L. alata*, and *L. paradoxa.*

This genus is distinguishable from the others in having large ctenoid scales.

The present genus is nearly endemic to the waters of Japan, its range extending from Hokkaidô to Formosa. However, a few species inhabit the Indian Ocean.

Key to species of *Lepidotrigla.*

a. Vomerine teeth wanting; rostral spines triangular, serrated on their margin except their tips, but without accessory spines; the distance between them at tips usually more than 1½ times of interorbital distance.

b. Distance between rostral apices broad, about twice of interorbital space; upper detached pectoral ray short, falling short of tip of ventral by a distance about one half of the diameter of eye ... ... *alata*, 5.

bb. Distance between rostral apices narrow, about 1.5 times of interorbital space; upper detached pectoral ray long, extends beyond tip of ventral, and reaches to the base of third anal ray ... ... *paradoxa*, nom. nov., 6.

aa. Vomer with teeth; rostral spines not triangular, less developed, entire on each margin, but with a varying number of accessory spines, the distance between their outer tips little more than the interorbital distance if any, but usually as long as it.

c. Pectoral very long, reaching to last fifth dorsal ray; palatine with two or three rows of minute teeth embedded in the skin; dorsal rays VIII or IX–15; anal 14 or 15; scales about 55; interorbital space much shorter than eye; suborbital stay much deeper than length of eye... ... ... *japonica*, 7.

cc. Pectoral moderate, not reaching to base of middle of dorsal; palatine toothless.

d. Upper detached pectoral ray reaching to almost or quite tip of ventral.

e. Second dorsal spine elongated, much longer than third, reaching to or beyond the insertion of second dorsal when fin is depressed, and its anterior edge strongly serrated.

f. Second dorsal spine much elongated, at least reaching to second ray of soft dorsal in young specimen, but in large ones much beyond the fourth ray when fin is depressed and much longer than depth of body; body slender, its depth about 4½ in body length; snout deeply emarginated; spinous dorsal with a very indistinct blotch posteriorly in young specimens; dorsal rays VIII–15 or 16; anal 15 or 16; scales 58 to 62; scutes on dorsal 22 to 24 ... ... *güntheri*, 8.

ff. Second dorsal spine comparatively short (but much longer than third) and feeble, scarcely reaching to the insertion of first ray of second dorsal when fin is depressed (in adult, and large specimens as well), much shorter than depth of body; body robust, its depth about 4 in body length; snout truncated at its anterior margin, provided with 4 or 5 large and distinct spines on each side; dorsal rays IX–15; anal 15; scales 59 to 62; scutes on dorsal 23; ventral reaching between vent and insertion of anal ... ... *teraoi*, sp. nov., 9.

ee. Second dorsal spine but little longer than third and its anterior edge weakly serrated; spinous dorsal without a dark blotch.

g. Body rather robust, its depth 4 to 4.2 in body length; a postorbital spine rudimentary; snout very short, equal or much shorter than eye; second dorsal spine reaching or past origin of second dorsal fin.

h. Snout equal or a little longer than length of orbit and just equal to the depth of suborbital stay; upper detached pectoral ray falling short of tip of ventral by a distance about equal to one-third the

length of eye; scutes on dorsal 23 or 24; dorsal rays VIII or IX–14 to 16; anal 15 to 16; scales 57 to 59... ... *abyssalis*, 10.

hh. Snout much shorter than diameter of orbit, about 1.37 in latter; orbit very large, longer than depth of suborbital stay (suborbital stay about 1.14 in orbit); upper detached pectoral ray reaching to tip of ventral; scutes on dorsal 22; dorsal rays VIII or IX–15; anal 15; scales 54 to 58... ... ... *hime*, sp. nov. 11.

gg. Body slender, its depth $4\frac{8}{10}$ in body length; snout much longer than orbit, 1.4 times of latter; two postorbital spines present, the outer one stout, sharp and forked; orbit large, longer than depth of suborbital stay; second dorsal spine not reaches to second dorsal fin, extends to base of last spine when fin is depressed scutes 24; dorsal rays IX–15; anal 15; scales 61 ... ... *spiroptera*, 12.

d. Upper detached pectoral ray falling short of tip of ventral by a distance about equal to the diameter of eye.

a′ The length of rostral spine very long, sharp and stout, just equal (in young specimens) or much longer (in large specimens) than one-third the length of eye, in the longest one subequal in length to latter; the distance between their apices much longer than diameter of eye, eye 0.68 to 0.88 times of former; first dorsal fin with a very faint black blotch in small specimens, but entirely disappear in adult ones; dorsal rays VIII or IX–15; anal 15; scales 57 to 60; scutes on back 23... ... ... *kishinouyei*, 13.

aa′ The rostral spine moderate, shorter than one-third the length of eye; the distance between their apices equal or shorter than length of eye.

b′ Second dorsal spine very short (but equal or longer than the third), much shorter than upper detached pectoral ray or than the depth of body, about 1.3 to 1.6 in latter; body rather robust.

c′ Second dorsal spine extremely short and weak, 1.6 in depth of body, 1.25 in upper detached pectoral ray; suborbital stay very high, much higher than diameter of eye and nearly equal to the length of snout; body very deep, 4 in body length; head very large, 3 in body length; a black blotch on first dorsal, and an obscure dark stripe along the soft dorsal; dorsal rays VIII or IX–15; anal 14; scales 58 to 63; scutes on back 23 to 26 ... *smithii*, 14.

cc′ Second dorsal spine short and stout, 1.2 in upper detached pectoral ray, 1.3 in depth of body; orbit very large, much longer than the depth of suborbital stay and equal to the length of snout; interorbital space shallowly concave, just equal to the length of eye; body rather robust; snout truncated at tip and each side represented by four distinct, large spines, but the outer one the longest; both dorsal fins blackish; preserved specimens show a sharp mid-line separating the upper grayish brown half from the lower silvery half; dorsal rays VIII–16; anal 17; scales 64; scutes on dorsal 24 ... ...

dd′ Second dorsal spine scarcely equal or somewhat shorter than depth of body and about 1.40 or more in head.

e′ Color dark brown in life.

f″ Body very deep, its depth about 4.1 in body length; eye very small, much shorter than depth of suborbital stay; ventral very short, scarcely reaches to vent; upper detached pectoral ray very short; interorbital space wider than diameter of eye; humeral spine much longer than eye; dorsal rays VIII or IX–16 to 18; anal 16 or 17; scales 64 to 66; scutes on back 24 or 25 ... ... *strauchi*, 17.

ff″ Body rather slender, its depth 4.5 in body length; eye large, longer than depth of suborbital stay; ventral long, reaches to third anal ray; pectoral to fifth or sixth anal ray; upper detached pectoral ray relatively long; interorbital space narrower than diameter of eye; humeral spine equal to the length of eye; dorsal rays IX–17; anal 17; scales 65; scutes on back 25 ... ... *brevispinis*, sp. nov., 18.

ee′ Color brick red in life; eye moderate, subequal to the depth of suborbital stay; humeral spine longer than diameter of eye; depth of body variable 5.55 to 4.30, head 3.89 to 3.20 in body length; interorbital space wider than length of eye; dorsal rays VIII or IX–16 to 18; anal 15 to 18; scales 62 to 68; scutes on back 24 to 26....*microptera*, 19.

5. *Lepidotrigla alata* (Houttuyn).

Japanese Name: Igodaka-hoderi.

? *Trigla alata* Houttuyn, 1782, p. 320.

Trigla bürgeri Temminck & Schlegel, 1850, p. 35, pl. XIV, Figs. 1 & 2; Steindachner & Döderlein, 1887, p. 5.

Lepidotrigla alata Schmidt, 1931, p. 120.

D. IX–16; A. 15; scales 61; dorsal shields 8+16; gill rakers 0+12; branchial rays 6.

Head 3.0 in body length; depth 3.75; orbit 3.7 in head; maxillary 2.9; interorbital space 3.5; first dorsal spine 2.2; second dorsal spine 1.8; third dorsal spine 1.8; fourth dorsal spine 2.2; pectoral 1.2; upper free pectoral ray 1.45; ventral 1.3; caudal 1.4.

Body rather elongate; upper profile of snout nearly straight; rostral processes in large triangular divergent spines, the length of which more than two-thirds the diameter of eye, and distance between their apices at tip nearly or quite twice the length of interorbital space, 2.2 times the diameter of orbit; interorbital space rather deeply concave, little longer than diameter of orbit; eye rather small, much shorter than snout, about 1.7 in snout, and 1.4 in depth of suborbital; supraorbital and postorbital spines obsolete; a

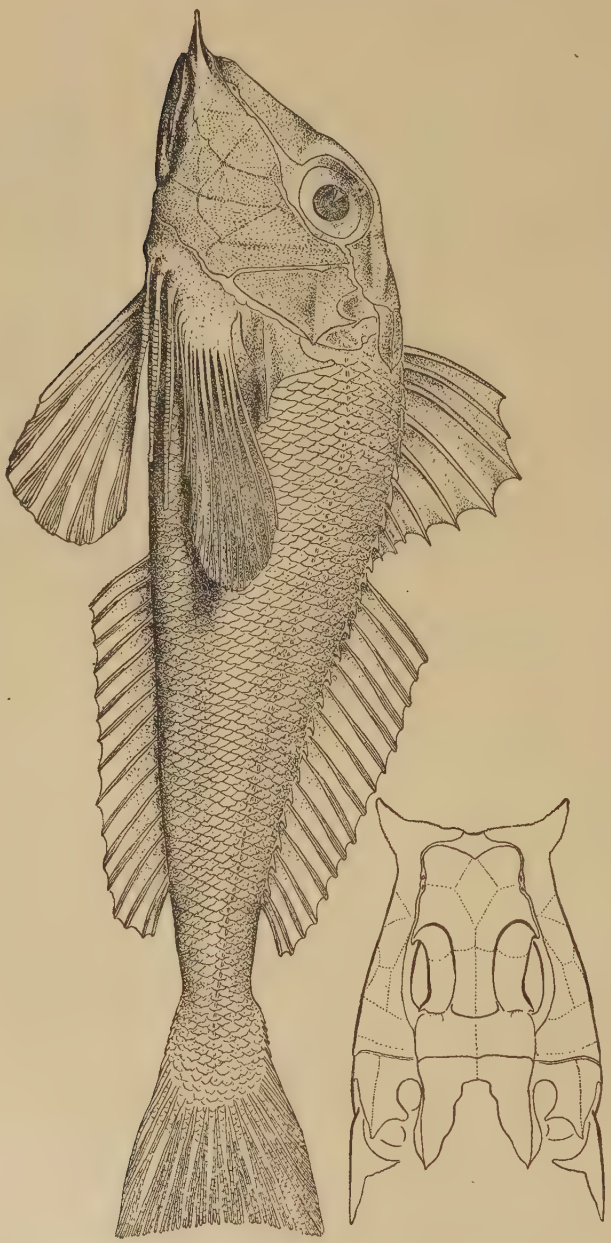


Fig. 7. *Lepidotrigla alata* (Houttuyn). ×⅓. (Hiyama del.)

very shallow indistinct furrow above posterior margin of eye; the furrows from both sides do not meet at the top of head; parietal ridges wanting; humeral spine long and pungent, 1.5 times of eye, reaching to the point vertical from sixth dorsal spine; maxillary scarcely reaching to beneath anterior margin of pupil; developed gill-rakers on first arch 0+12, others rudimentary, short and heavy, longest (third) raker 5 in orbit; teeth on jaws rather narrow; vomer toothless, appears only as ridge covered with skin; palatines also toothless.

Second and third dorsal spines subequal in length, and about 1.3 in upper detached pectoral ray; first, second and third spines serrated; pectoral reaches to the third anal ray; upper detached pectoral ray falls short of tip of ventral ventral reaches to the second anal ray.

Color in formalin uniformly light brown, paler below, and without markings; inner side of pectoral blackish, except uppermost one and lowermost three rays; other fins whitish. In life brick red.

Described from a female specimen measuring 199 mm. long in total, got from Sagami Bay, deposited in the museum of Fishery Institue, Faculty of Agriculture, Tokyo Imperial University.

There is no room for doubt that the present species is identical with Temminck and Schlegel's *Trigla bürgeri* since their specimen as given in their description and figure (*loc. cit.*) tallies completely with the material at our disposal. It should be noted, however, that although Jordan and Starks (1902) synonymized *Trigla bürgeri* T. and S. with *T. alata* H., Jordan and Richardson (1908) described and illustrated a species which is distinct from *T. bürgeri* T. and S. under the name of *L. alata* (Houttuyn). It follows therefore that a new name should go with that species as will be discussed later on.

Five specimens have come under our examination: one from Sagami Bay and four from the China Sea.

Habitat.—From China Sea to Tokyo Bay.

6. *Lepidotrigla paradoxa*, nom. nov.

New Japanese Name: Kawari-igodaka.

Lepidotrigla alata Jordan & Richardson, 1908, p. 650 (nec *T. alata* Houttuyn).

D. VIII–16; A. 16; dorsal shields 8+16; scales 60; gill-rakers 0+9; branchial rays 6.

Head 3.2 in body; depth 3.8; orbit 3.7 in head; snout 2.0; maxillary 2.7; interorbital 3.5; first dorsal spine 2.25; second dorsal spine 1.7; third dorsal spine 1.8; fourth dorsal spine 2.2; pectoral 1.1; longest free pectoral ray 1.3; ventral 1.45; caudal 1.4.

Body rather elongate; upper profile of snout nearly straight, slightly convex at anterior portion; nasal processes in large triangular spines, length of which about 2/3 times of diameter of eye, distance between their apices 1.4 times of interorbital space, 1.55 times of length of orbit (the preserved specimen has its mouth and opercles opened, so that apices may be much closer with each other than in life. When distance between their apices measured with its mouth shut, it becomes 1.55 times of interorbital space.

The figure is drawn true to specimen in its preserved condition.); orbit rather small; much shorter than snout, 1.9 in it; shape of orbit somewhat elliptic,

Fig. 7. *Lepidotrigla paradoxa*, nom. nov. ×$\frac{4}{5}$. (Hiyama del.)

horizontal diameter much longer than vertical; suborbital stay longer than length of orbit, about 1.3 times of it; supraorbital and postorbital spines obsolete; a very shallow furrow above posterior margin of eye, which abruptly interrupted just at the middle way from side to the dorsal median line of the body; parietal ridges wanting; humeral spine long, about 1.3 times of eye, reaching to the point vertical from fifth dorsal spine; maxillary ends far in front of the anterior margin of orbit; gill rakers on first arch 0+9, others rudimentary, second longest, 6.5 in orbit.

Second dorsal spine longest, spines are rather feeble, first and second serrated; pectoral reaches to the fourth anal ray; upper detached pectoral ray long, extends well beyond insertion of anal and reaches to the base of third anal ray, slightly longer or nearly equal to ventral, which reaches to the base of second anal ray; teeth on jaws in rather narrow bands; vomerine ridge without teeth; no teeth on palatine.

Color in formalin light brown, fainter below, without any marking; inner side of the pectoral blackish, except upper two and lower three rays; other fins plain, in life probably red.

Described from a female specimen measuring 196 mm. long in total, from Kumamoto, got by Dr. Y. Wakiya. Deposited in the museum of Fishery Institute, Faculty of Agriculture, Tokyo Imperial University.

From *L. alata,* the present species differs markedly in its narrower distance of rostral apices, and much longer detached pectoral ray.

This fish exactly agrees with description and figure of Jordan & Richardson's *L. alata,* but differs from Temminck & Schlegel's *T. bürgeri,* which is a synonym of *L. alata* (Houttuyn), in having much narrower distance of apices and much longer detached pectoral ray.

One specimen from Kumamoto.

Habitat.—Shores of southern Japan.

7. *Lepidotrigla japonica* (Bleeker).

Japanese Name: Toge-kanagasira.

Prionotus japonicus Bleeker, 1857, p. 75, pl. V. Fig. 1; Günther, 1860, p. 196.
Lepidotrigla japonica Steindachner and Döderlein, 1887, IV, p. 264; Jordan and Starks, 1902, p. 596, Fig; Jordan and Richardson, 1908, p. 654; Franz, 1910, p. 79; Jordan and Hubbs, 1925, p. 289; Schmidt, 1931, p. 121.

Head 3.4 in body length; depth 4; orbit 3.3 in head; snout 2.4; maxil-

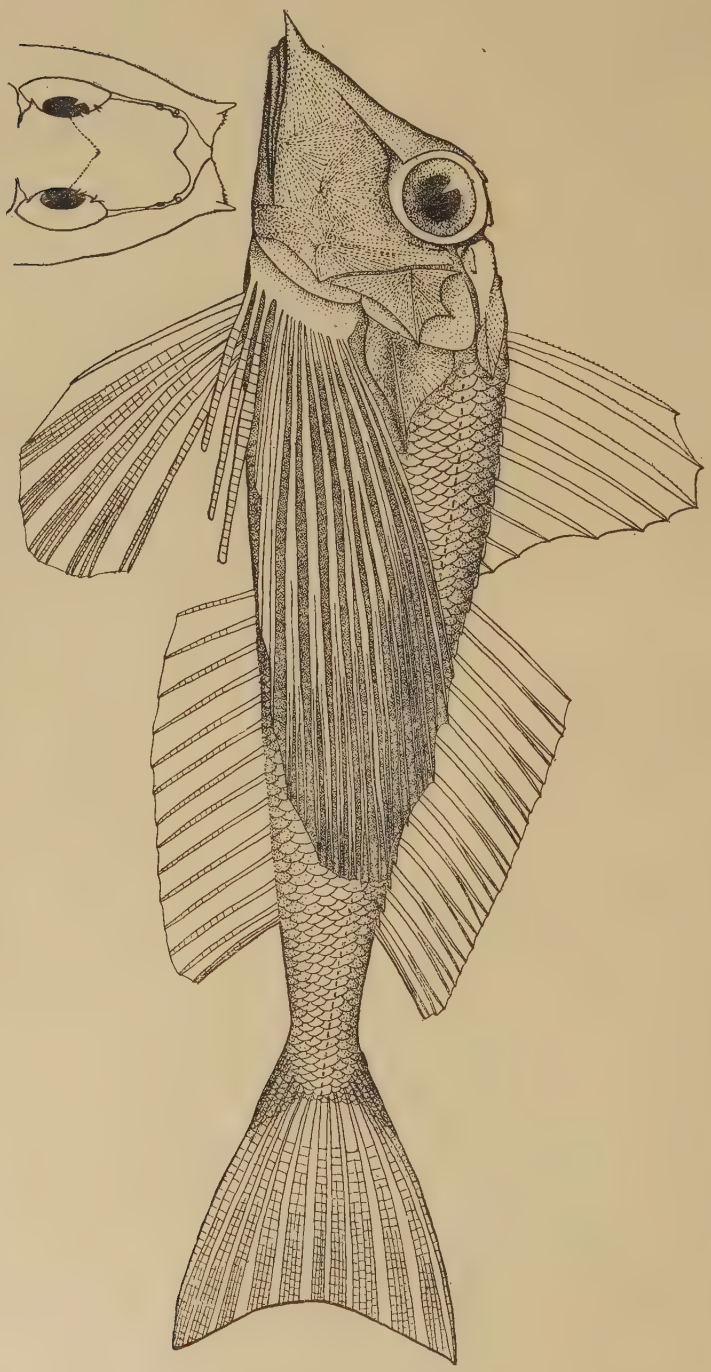


Fig. 8. *Lepidotrigla japonica* (Bleeker). ×1. (Matsubara del.)

lary 2.1; interorbital space 4.4; first dorsal spine 1.6; second spine 1.4; third spine 1.4; fourth spine 1.6; pectoral 0.56; ventral 0.97; caudal 0.99; D. IX–14; A. 14; scales 58; scutes on dorsal 22.

Snout moderately emarginated, each prominence of snout with fine serrations and a large spine at each angle, the distance between their apices slightly longer than diameter of orbit; interorbital space deeply concave and shorter than diameter of orbit, 1.33 in latter; orbit rather small, much shorter than snout or than depth of suborbital stay, 1.2 in suborbital stay; supraorbital spines rather sharp; postorbital with two small spines; a deep cross-furrow above posterior margin of eye, which does not meet across top of very rough head; parietal ridges small; humeral spine long and sharp, 1.4 times of orbit and reaching beyond vertical from fifth dorsal spine; nuchal spine reaching to base of third dorsal spine; maxillary reaching to beneath anterior margin of pupil; developed gill-rakers on first arch 0+6 (including the rudimentary ones 1+9), the longest one (third one) 4.2 in orbit.

Second dorsal spine equal to the length of third spine; pectoral reaches to twelfth ray of soft dorsal; upper detached pectoral ray falling short of tip of ventral by a distance about equal to the length of eye; ventral reaching to third anal ray.

Color in formalin light brown above, sharply silvery below; inside of pectoral black on the lower half, grayish yellow on the upper with several black cross lines; other fins plain.

Described from a female specimen 175 mm. in total length, taken from Nagasaki, Imp. Fisheries Inst. Mus. No. 9.

The extension of pectoral has been known to vary. It was described by Bleeker (1857, p. 75) and Günther (1860, p. 196) to reach to the base of 10th anal ray, but by Jordan and Richardson (1908, p. 655) to that of 11th or 12th, by Steindachner and Döderlein (1887, p. 9) to that of 12th or 14th. Of ten specimens examined four extend it to the base of 12th, five to that of 11th, and one to that of 10th. The table on next page shows that this and other characters vary almost irrespective of sex, age, and locality.

The specimen No. 10 of the table has the outermost spine at each angle of snout as long as the other five ones situated proximally. In No. 3 the supraorbital spine is rudimentary. The suborbital stay is lower in smaller specimens, but higher in larger ones, measuring just as long as orbit in No. 9 (124 mm. long) but 1⅕ as long as orbit in a specimen 133 mm. long.

It is worth noting that all the ten specimens already mentioned have two or three closely set series of minute villiform teeth embedded in the skin

TABLE I.

Specimen No.	1	2	3	4	5
Locality	Nagasaki	Nagasaki	Misaki	Misaki	Misaki
Sex	♀	♀	♀	♂	♀
Total length	175 mm.	171 mm.	172.8 mm.	154.5 mm.	148 mm.
Depth in body length	4	4.67	4.0	4.34	4.41
Head in body length	3.4	3.27	3.40	3.13	3.22
Extension of pectoral	12th anal ray	12th anal ray	11th anal ray	11th anal ray	11th anal ray

Specimen No.	6	7	8	9	10
Locality	Misaki	Misaki	Misaki	Misaki	Tokyo Bay
Sex	♀	♀	♂	♀	♀
Total length	146 mm.	144 mm.	135.5 mm.	124 mm.	182 mm.
Depth in body length	4.41	4.15	4.03	4.46	4.48
Head in body length	3.31	3.29	3.27	3.14	3.37
Extension of pectoral	11th anal ray	12th anal ray	12th anal ray	11th anal ray	10th anal ray

of palatine, although absence of teeth on palatine was regarded by Günther (1860, p. 196) and Jordan and Richardson (1908, p. 649) as one of the characters of the genus *Lepidotrigla*, and their uniserial feeble development was put on record by Günther (1860, p. 196) in *Prionotus japonicus* (= *Lepidotrigla japonica*) as: "palatine teeth very minute, in a very narrow band." The above-mentioned differences appear to be slight enough to include all the specimens under this species which is distinguished from the other species

of this genus by deep concavity of interorbital space which is shorter than diameter of eye or distance between the apices of the two rostral spines, by short second dorsal spine which is almost as long as the third dorsal spine, by rough top of head, and by longer extension of pectoral.

Thirty specimens from Nagasaki, seven from Misaki, and one from Tokyo Bay.

Habitat.—Widely distributed throughout the warmer waters of the Japanese Empire, especially abundant in Kyûsyû.

8. *Lepidotrigla güntheri* Hilgendorf.

Japanese Name: Kanado.

Lepidotrigla güntheri Hilgendorf, 1879, p. 106; Jordan and Starks, 1902, p. 594; Jordan and Richardson, 1908, p. 653; Franz, 1910, p. 79; Tanaka, 1914, V. 15, p. 261; Jordan and Hubbs, 1925, p. 289; Schmidt, 1931, p. 121.
Lepidotrigla longipinnis Steindachner and Döderlein, 1887, p. 262, pl. IV, Fig. 1.

Head 3.3 in body length; depth 4.4; orbit 3.45 in head; snout 2.8; maxillary 2.4; interorbital space 3.6; first dorsal spine 1.9; second spine 1.10; third spine 1.63; fourth spine 2.04; pectoral 1.17; ventral 1.16; caudal 1.28; D. VIII–16; A. 15; scales 60; scutes on dorsal 23.

Body rather slender, fusiform, tapering from origin of first dorsal to the slender caudal peduncle.

Snout moderately emarginated; upper profile of snout slightly concave; lateral prominences broad and unevenly serrated, the outer spine the largest, the distance beteen apices of the longest spine somewhat wider than diameter of orbit; interorbital space deeply concave; supraorbital spine rather weak; humeral spine a little longer than diameter of orbit; two small postocular spines present; a cross-furrow behind eye does not extend across occiput; depth of suborbital stay rather longer than orbit, maxillary extending to anterior margin of eye ball; six developed gill-rakers present on lower limb of first gill arch. Dorsal scutes pungent.

First dorsal spine much shorter than third or fifth dorsal spine, extending to seventh spine when fin is depressed; second dorsal spine very long, reaching to fourth ray of second dorsal when spine is depressed. Upper detached pectoral ray falling short of tip of ventral by a distance equal to about one-half the length of eye; pectoral reaching to opposite base of second anal ray. Ventral extends to first anal ray.

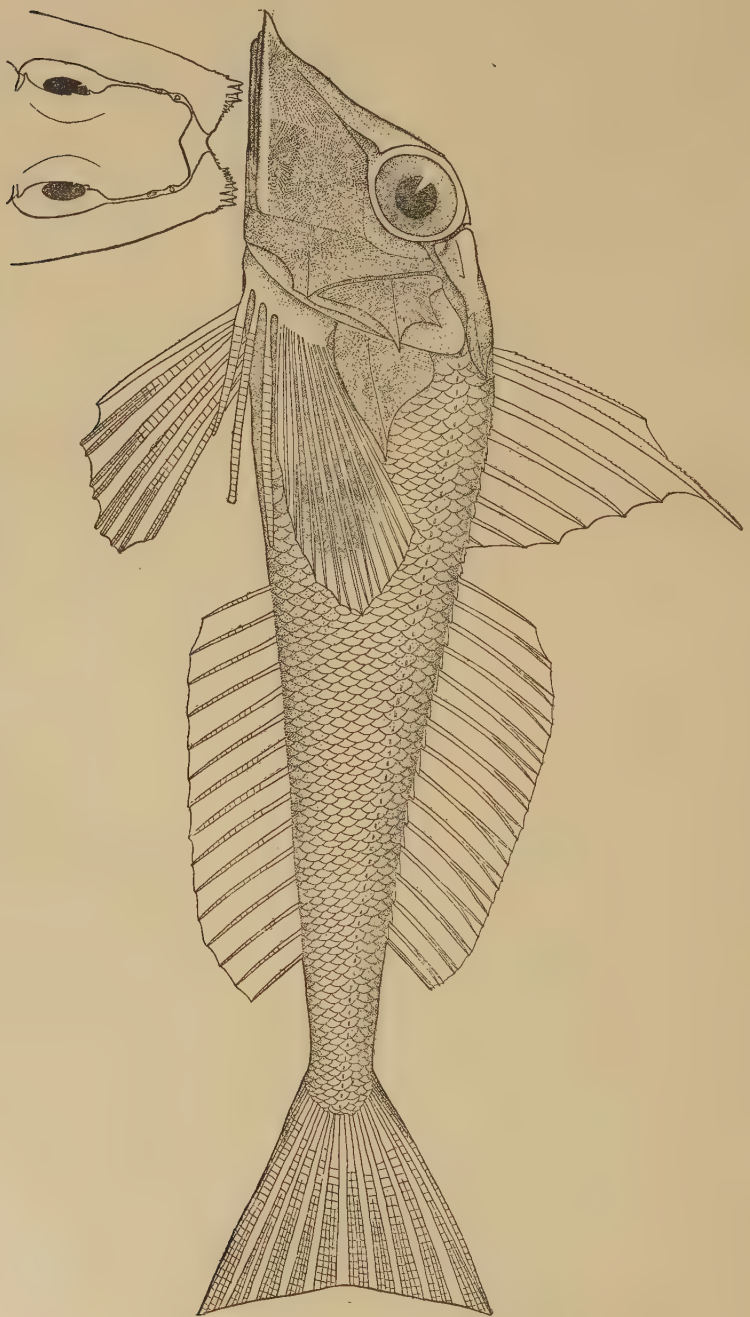


Fig. 9. *Lepidotrigla günthéri* Hilgendorf. $\times \frac{6}{4}$. (Matsubara del.)

Color in formalin pale brown, without darker bands; pectoral grayish black within, but the lowermost three rays and distal margin whitish; other fins pale.

Described from a female specimen 226 mm. in total length, from Misaki; Imperial Fisheries Institute Mus. No. 10.

A striking local variation was seen in a Korean specimen (Fig. 10) in which the first dorsal spine is not shorter but longer than the third, and pectoral extends beyond the base of second or third anal ray and reaches to that of the fifth. However, this specimen agrees altogether with the type in other respects. The measurements of four other specimens are as follows:—

TABLE II.

Specimen No.	1	2	3	4
Locality	Korea	Unknown	Misaki	Suruga Bay
Sex	♀	♀	♀	♀
Total length	211.0 mm.	197 mm.	158 mm.	141 mm.
Head in body length	3.2	3.1	3.1	3.2
Depth in body length	4.4	4.15	4.24	4.5
Orbit in head	3.3	3.5	3.1	3.2
Snout in head	2.7	2.43	2.50	2.57
Interorbital in head	4.5	4.4	4.3	4.0
First dorsal spine in head	2.25	2.14	2.4	1.72
Second dorsal spine in head	1.18	1.28	1.5	1.24
Third dorsal spine in head	1.80	1.76	1.83	1.62
Fourth dorsal spine in head	2.1	2.1	2.3	2.05
Pectoral in head	1.1	1.30	1.18	1.15
Ventral in head	1.23	1.36	1.26	1.20
Distance between apices of rostral apine in eye	0.87	?	1.25	1.02
Orbit in depth of suborbitastay	1.11	1.1	0.95	1.07
Orbit in humeral spine	1.13	?	0.80	0.95

Fig. 10. *Lepidotrigla güntheri* Hilgendorf. ×$\frac{1}{1}$. (Matsubara del.)

The second dorsal spine grows more rapidly than other parts of the body so that it is 1.5 in head in No. 3 but 1.18 in No. 1 as shown in the preceding table. The serration on the anterior border of the first three dorsal spines sharpens as the age of the specimen advances. Both the postorbital and preorbital spines are more acute in younger individuals. Smaller specimens (e. g., No. 4 in the table) have five distinct cross-bands of grayish brown color on body; each two beneath first and second dorsal fin, and one on caudal peduncle. A band of the same color crosses the middle of caudal fin. Diffuse grayish brown spots scatter on first dorsal, pectoral, and also on head. A longitudinal band of the same color runs near the margin of second dorsal. However, all these markings either altogether disappear or become much fainter in larger specimens.

Numerous specimens from Misaki, Suruga Bay, Nagasaki, and Huzan (Tyôsen).

Habitat.—From Tôkyô southward to Kyûsyû.

9. *Lepidotrigla teraoi*, sp. nov.

New Japanese Name: Terao-kanado.

Head 3.1 in body length; depth 4.1; orbit 3.55 in head; snout 2.2; maxillary 2.6; interorbital space 4.1; first dorsal spine 2.76; second spine 1.44; third spine 1.8; fourth spine 2.25; pectoral 1.18; ventral 1.36; caudal 1.36; D. IX–15; A. 15; scales 59; scutes on dorsal 23.

Body stout and deep; head rather large and high. Snout truncate at tip, 4 or 5 rather large spines projecting at each angle, the distance between apices of largest rostral spines much wider than diameter of orbit; the upper profile of snout slightly concave; interorbital area deeply concave; two supraorbital spines present; humeral spine rather short, equal to the diameter of orbit; plates of head rugose; a pair of slight tubercular projections on parietal region; a deep cross-furrow above posterior margin of eye, slightly extends across occiput; depth of suborbital stay slightly longer than diameter of orbit; mouth small, the cleft scarcely reaching to anterior margin of orbit; gill-rakers much rounded, 0+5 on first arch.

Second dorsal spine not so large as that of *L. güntheri*, scarcely reaching to second dorsal when fin is depressed, but much longer than third dorsal spine; the third and those of succeeding ones not reaching to second dorsal; the first spine reaching to base between sixth and seventh spines; upper

Fig. 11. *Lepidotrigla teraoi*, sp. nov. $\times \frac{3}{4}$. (Matsubara del.)

detached pectoral ray falling short of tip of ventral by a distance equal to one-fourth the diameter of eye; pectoral reaching to opposite base of first anal ray; ventral short, reaching between vent and insertion of anal fin; each side of dorsal fins bordered by a row of spinous scutes, those except anteriormost three ones being strong and sharply pointed.

Color brick red in life, whitish below, but in formalin brownish light yellow, with six indistinct blackish cross shades, two under spinous dorsal, three under soft dorsal and one at base of caudal; pectoral gray in life, crossed with about five brick red bars, back grayish green except sixth to eighth rays which are blackish purple excluding margin, and mottled with light purple; dorsals, ventrals, and caudal light red; first dorsal furnished with brick red bars; anal white.

The foregoing description is based upon a female specimen 241.5 mm. in total length from Tokyo Bay; Imperial Fisheries Institute Mus. No. 11.

The proportions of the different parts of the body slightly vary as follows:—

Table III.

Total length	237 mm.	235 mm.	225 mm.
Sex	♀	♂	♀
Head in body length	3.25	3.3	3.24
Depth in body length	4.00	4.3	4.4
Orbit in head	3.4	3.14	3.4
Snout in head	2.67	3.0	2.87
Maxillary in head	2.3	2.4	2.4
Interorbital space in head	4.0	3.7	3.8
Pectoral in head	1.06	1.13	1.14
Ventral in head	1.20	1.24	1.24
Orbit in depth of suborbital stay	1.14	1.0	1.14
Orbit in humeral spine	1.09	1.04	1.12

As shown above, there are no remarkable individual variations, except the orbit slightly longer in males than in females.

This species is distinguished from *L. güntheri* (Hilgendorf) in having

delicate second dorsal spine which scarcely reaches to the insertion of second dorsal, truncated rostrum with four or five spines of nearly same size, larger head, and deeper body. The slight difference between the length of second and third dorsal spines puts this species just between *L. güntheri* and *L. abyssalis*, but sharp serration on the anterior margin of first three dorsal spines places the present species near to *L. güntheri*.

Habitat.—Tokyo Bay.

Lepidotrigla abyssalis Jordan and Starks.

Japanese Name: Soko-kanagasira.

Lepidotrigla japonica Nyström, 1887, p. 23 (Name preoccupied).
Lepidotrigla abyssalis Jordan and Starks, 1902, p. 595; Jordan and Richardson, 1908, p. 654; Jordan and Hubbs, 1925, p. 289.

Head 3.2 in body length; depth 4; orbit 2.9 in head; snout 2.9, 2.86 when measured to tip of spine; maxillary 2.5; interorbital space 3.5; first dorsal spine 1.78; second spine 1.44; third spine 1.64; fourth spine 1.9; pectoral 1.0; ventral 1.12; caudal 1.11; D. IX–15; A. 15; scales 59; scutes on dorsal 23.

Snout just equal to the length of orbit, but slightly longer than latter when measured to tip of rostral spine; upper profile of snout nearly straight, almost truncated at tip, lateral prominences broad and armed with a rather broad axial spine and a several small accessory ones; distance between apices of largest spines slightly shorter than diameter of orbit, about 1.07 in it; interorbital space deeply concave, and a little narrower than orbit, 1.2 in orbit; orbit moderate, equal to the length of snout or to depth of suborbital stay; supraorbital spines rudimentary, postorbital with one rudimentary spine; parietal ridges rudimentary, a sharp and serrated ridge running backward from upper postorbital furrow; nuchal spines and ridges feeble; a short narrow cross-furrow above posterior margin of eye, not extending across top of head; humeral spine slightly shorter than diameter of orbit (about 0.82 times of orbit); maxillary a little past beneath anterior margin of pupil; developed gill-rakers on first arch 0+7 (including the rudimentary ones 1+10), rather long and slender, 5.5 in orbit.

Second dorsal spine the longest, but scarcely reaching to insertion of second dorsal, when fin is depressed; the second to seventh spines coterminal; the first spine reaches to base of seventh spine; upper detached pectoral ray

Fig. 12. *Lepidotrigla abyssalis* Jordan and Starks. ×1⅓. (Matsubara del.)

falling short of tip of ventral by a distance equal to about one-third the length of eye; ventral reaches to opposite base of third anal, pectoral to fourth anal ray.

Color in life bright red, somewhat paler below, the first dorsal fin with a large brick red blotch posteriorly; in formalin body uniformly light brown without marking, pectoral blackish within, free pectoral rays each with a blackish shade on middle parts.

The foregoing description is based upon a female specimen 132 mm in total length from the Tokyo Bay; Imperial Fisheries Institute Mus. No. 12.

Except the depth of body, the proportions of the bodily parts present very slight variations as given in the following tables:—

TABLE IV.

Specimen No.	1	2	3	4	5
Locality	Misaki	Misaki	Tokyo Bay	Tokyo Bay	Tokyo Bay
Sex	♀	♀	♀	♀	♀
Total length	150 mm.	135.5 mm.	137.0 mm.	132.8 mm.	128 mm.
Head in body length	3.47	3.49	3.49	3.38	3.30
Depth in body length	4.15	4.15	4.36	3.78	4.10
Orbit in head	3.06	2.94	2.85	2.91	2.91
Snout in head	3.06	2.92	2.85	2.91	2.74
Maxillary in head	2.47	2.50	2.49	2.48	2.47
Interorbital space in head	3.10	3.0	3.23	3.05	3.61
First dorsal spine in head	1.61	1.60	1.90	1.83	1.88
Second dorsal spine in head	1.27	1.28	1.37	1.32	1.40
Third dorsal spine in head	1.47	1.40	1.52	1.51	1.52
Fourth dorsal spine in head	1.67	1.66	1.81	1.75	1.83
Pectoral in head	0.95	0.85	0.92	1.02	1.02
Ventral in head	1.11	1.03	1.1	1.16	1.02
Distance between rostral spines in eye.	1.0	1.08	1.1	1.21	1.08
Orbit in depth of suborbital stay	1.08	1.08	1.0	1.05	1.0
Depth of caudal peduncle in head	5.26	5.1	5.47	5.0	5.35
Humeral spine in orbit	1.08	1.07	1.32	1.26	1.26

TABLE V.

Specimen No.	6	7	8	9
Locality	Tokyo Bay	Tokyo Bay	Tokyo Bay	Tokyo Bay
Sex	♀	♀	♀	♀
Total length	127.0 mm.	122.0 mm.	120 mm.	119.0 mm
Head in body length	3.3	3.27	3.43	3.37
Depth in body length	4.1	4.44	4.42	4.01
Orbit in head	3.0	2.86	2.86	2.89
Snout in head	3.0	2.77	2.86	2.60
Maxillary in head	2.5	2.53	2.64	2.60
Interorbital space in head	3.4	3.42	3.29	3.66
First dorsal spine in head	1.74	1.60	1.80	1.88
Second dorsal spine in head	1.40	1.31	1.24	1.45
Third dorsal spine in head	1.56	1.43	1.46	1.52
Fourth dorsal spine in head	1.90	1.71	1.77	1.75
Pectoral in head	0.97	0.93	0.95	0.99
Ventral in head	1.07	1.01	1.1	1.08
Distance between rostral spine in eye	1.16	1.33	1.11	1.22
Orbit in depth of suborbital stay	1.01	0.96	1.02	1.0
Depth of caudal peduncle in head	?	5.47	5.20	5.35
Humeral spine in orbit	1.07	1.28	1.39	1.39

It is worth while to mention that *Lepidotrigla abyssalis* is shown in Jordan and Stark's figure (1902, p. 595, fig.) to have caudal fin rounded and depth of suborbital stay less than diameter of orbit. Our specimens of the genus Lepidotrigla are, on the other hand, all provided with either truncate on emarginated caudal fin, and 53 specimens of this species under our examination with emarginated caudal. We are inclind to regard this discrepancy as a draugtsman's mistake. We also venture to assume that the delineation of relative position of suborbital stay and orbit was not exact in the above-mentioned authors' work since all the specimens at our disposal have

depth of suborbital stay the same as diameter of eye. Even if such discrepancies be real, our specimens should be referred to the present species since agreement in other important characters is beyond doubt.

The species can be distinctly distinguished from others in the following points: snout equal or slightly longer than orbit; orbit rather small, equal to the depth of suborbital stay; the upper detached pectoral ray falling short of tip of ventral by a distance equal to one-third the length of eye; and second dorsal spine scarcely reaching to insertion of soft dorsal fin.

Fifty specimens from Nagasaki; three from Misaki.

Habitat.—Southern Japan, abounds in the seas of Kyûsyû.

Lepidotrigla hime, sp. nov.

New Japanese Name: Hime-sokokanagasira.

Head 3.4 in body length; depth 3.9; orbit 2.6 in head; snout 3.62; maxillary 2.6; interorbital space 3.0; first dorsal spine 1.66; second spine 1.35; third spine 1.4; fourth spine 1.64; pectoral 0.93; ventral 1.07; caudal 1.12; D. IX–15; A. 15; scales 54; scutes on dorsal 22.

Body rather robust and high. Snout very short, much shorter than orbit, 1.37 in latter; upper profile of snout nearly straight; snout slightly emarginated at tip, lateral prominences broad, serrated with several small spines and a large spine produced at each angle; the distance between apices of the largest spine slightly shorter than diameter of orbit, about 1.21 in eye; interorbital space deeply concave, its width narrower than diameter of orbit, 1.33 in latter. Orbit large, longer than depth of suborbital stay (suborbital stay about 1.14 in orbit); supraorbital spines very feeble; postorbital with a rudimentary spine; a slight ridge on parietal region; a slight but sharp ridge-like spine running backward from the upper posterior border of postorbital furrow; nuchal spines and ridges feebler than other species of *Lepidotrigla;* a short narrow cross-furrow above posterior margin of eye, not extending across top of head; humeral spine much shorter than eye (0.76 times of eye); opercular spine feeble; maxillary extending to beyond the anterior margin of pupil (nearly to center of pupil); developed gill-rakers on first arch 0+7 (including the rudimentary ones 1+12), rather long, about 6 in diameter of eye.

Second dorsal spine the longest, though slightly longer than the third spine, the tip reaches to insertion of soft dorsal when fin is depressed; the

Fig. 13. *Lepidotrigla hime*, sp. nov. ×1½. (Matsubara del.)

second to sixth spines coterminal; the first spine reaches to base of eighth spine; upper detached pectoral ray just reaches to tip of ventral; ventral extending to third anal ray; pectoral reaching to opposite base of seventh anal ray.

Color in formalin uniformly brown and without markings; pectoral blackish within.

Described from a female specimen, 152 mm. in total length, taken from Misaki, Imperial Fisheries Institute Mus. No. 13.

The measurements of another specimen from Suruga Bay, which is 132 mm. in total length, are as follows: head 3.5 in body length; depth 4.0; orbit 2.6 in head; snout 3.2; maxillary 2.4; interorbital space 3.4; first dorsal spine 1 66; second dorsal spine 1.26; third dorsal spine 1.4; fourth spine 1.64; pectoral 0.98; ventral 1.12; caudal 1.05; distance between apices of longest rostral spines 1.28 in orbit; depth of suborbital stay 1.17; humeral spine 1.32; first dorsal spine equal to fourth spine; longest detached pectoral ray reaching to tip of ventral. In this specimen the parietal ridge is entirely wanting.

This species differs from *Lepidotrigla abyssalis* Jordan and Starks in having snout steeper in profile, much shorter than orbit, 1.37 in it; larger orbit, much longer than depth of suborbital stay; longer second spine, reaching or slightly beyond origin of second dorsal fin when fin is depressed; longer detached pectoral ray, its upper detached pectoral ray just reaching to tip of ventral; and deeper body.

The species is related to *Lepidotrigla spiroptera* Günther, but distinctly differs from it in having much shorter snout; longer second dorsal spine; a rudimentary postorbital spine; and a stout spine at each angle of nasal prominence.

One specimen from Misaki, and another from Suruga Bay.

Habitat.—This species seems to be rare, but possibly distributed in warmer waters of Japan.

(*hime*, a young lady of noble birth in Japanese).

Lepidotrigla spiroptera Günther.

New Japanese Name: Turanaga-sokokanagasira.

Lepidotrigla spiroptera Günther, 1879, 1, p. 42, Fig.

Head 3.1 in body length; depth 4.4; orbit 3.2 in head; snout 2.49; maxillary 2.4; interorbital space 5.1; first dorsal spine 2.2; second spine

1.77; third spine 1.9; fourth spine 2 2; pectoral 1.10; ventral 1.29; caudal 1.24; D. IX–15; A. 15; scales 61; scutes on dorsal 24.

Body slender; head large and heavy; snout very long, much longer

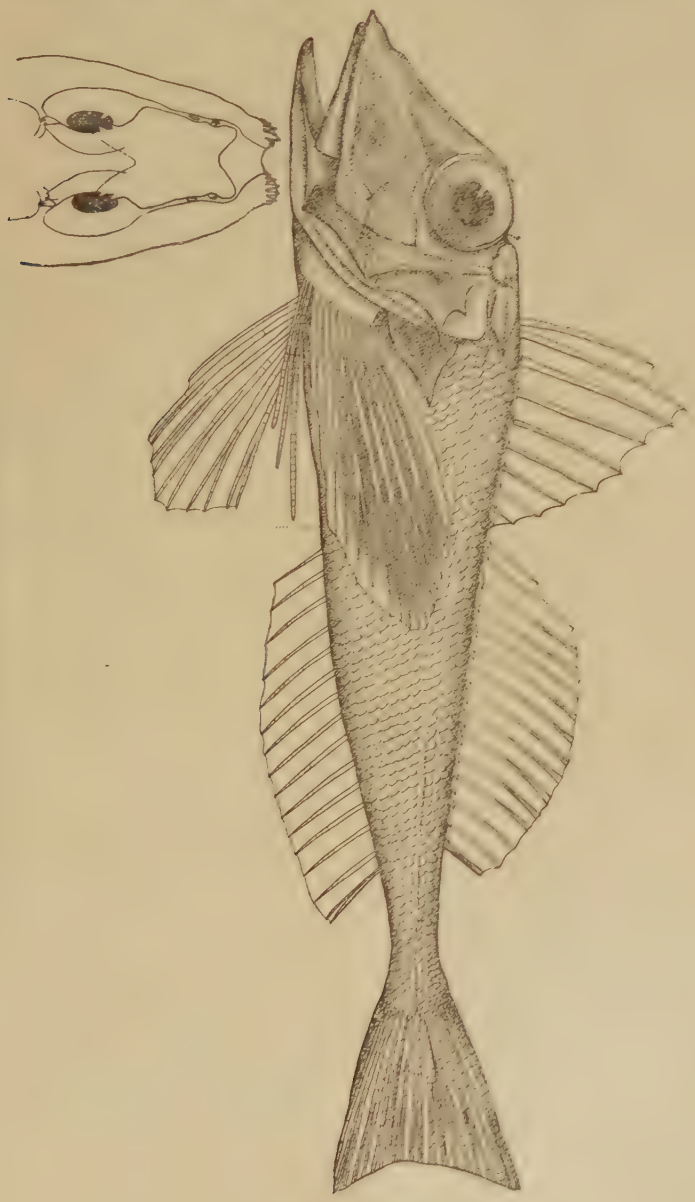


Fig. 14. *Lepidotrigla spiroptera* Günther. ×½. (Matsubara del.)

than orbit and its upper profile slightly concave; snout emarginated at tip and the lateral prominences rather broad, serrated with five distinct spines; the distance between apices of outer spines slightly shorter than diameter of orbit; interorbital space deeply concave and very narrow, 1.48 in eye; orbit very large, longer than the depth of suborbital stay; supraorbital spines stout and pungent; two spines present on postorbital, the outer one very stout and forked; small and sharp ridge in parietal region; a sharp ridge-like spine running transversely from the upper posterior border of postorbital furrow; nuchal spines and ridges well developed; a deep cross-furrow above posterior margin of eye, slightly extending across top of head; humeral spine nearly equal to the diameter of eye; opercular spine long and sharp; maxillary extends to anterior margin of orbit; well-developed tubercle-like gill-rakers on first arch 0+7 (including the rudimentary ones 1+8).

First dorsal spine reaches to base of seventh spine; second spine the longest, slightly longer than the third spine; the tip of second spine reaches to base of last spine but not to the tip of the following spines; the third to seventh spine coterminal; upper detached pectoral ray nearly reaching to tip of ventral; ventral scarcely extending to base of first anal ray; pectoral reaching to opposite base of sixth anal ray.

Color in formalin uniformly light brown without any markings; pectoral blackish within; all other fins plain, without marks.

Described from a male specimen taken in Suruga Bay by Mr. Daijiro Kusakabe. It is 195 mm. in total length; Imperial Fisheries Institute, Mus. No. 14.

This single specimen differs from the one described by Günther (1891, p. 42, Fig.) in having somewhat longer snout, but quite agrees with it in having very narrow and deeply concave interorbital space, a deep transverse groove behind eye, the second spine not reaching to second dorsal fin, but extending to last dorsal spine, and in number of dorsal and anal rays.

From *Lepidotrigla abyssalis* this species is distinguished by the snout much produced, 1.3 times of eye, two large postorbital spines, the outer one of which is larger and forked, the second spine of dorsal falling short of insertion of second dorsal by a distance equal to one-third the length of eye, narrower interorbital space, and more elongate body.

This species is again distinctly separated from *L. hime* in having much longer snout, shorter second dorsal spine, forked postorbital spine, narrower interorbital space and much tapering body.

This is also closely allied to Indian species *Lepidotrigla alcocki* Regan

(1907, p. 240, Pl. 28, Fig. 4.), but can be easily distinguished from it by the following characters:—

L. spiroptera	*L. alcocki*
1. Second dorsal spine longer than third, reaching to base of last spine.	1. Second dorsal spine shorter than third, extends to base of antepenult spine.
2. Upper detached pectoral ray nearly extends to tip of ventral, but not reaching to insertion of anal fin.	2. Upper detached pectoral ray very long reaching beyond tip of ventral and extends to base of second anal ray.
3. Postorbital spines long, the outer one forked.	3. Postorbital spines small, not forked.
4. Snout much longer than diameter of orbit.	4. Snout somewhat longer than diameter of orbit.
5. Interorbital space relatively wide, 5.1 in head.	5. Interorbital space narrower, 6 to $6\frac{1}{2}$ in head.

One specimen has come under our examination.

Habitat.—From Arafura Sea to Suruga Bay. This species is new to fauna of Japan.

Lepidotrigla kishinouyei Snyder.

New Japanese Name: Kishinouye-kanagasira.

Lepidotrigla kishinouyei Snyder, 1911, p. 543, pl. 56, Fig. 3; Jordan and Hubbs, 1925, p. 290.

Head 3.4 in body length; depth 4 35; orbit 3.5 in head; snout 2.57; maxillary 2.4; interorbital space 3 95; first dorsal spine 2.1; second dorsal spine 1.7; third dorsal spine 1 55; fourth dorsal spine 1.7; pectoral 0.94; ventral 1.07; caudal 1.18; depth of caudal peduncle 6.2; D. VIII–15; A. 15; scales 60; scutes on dorsal 23.

Snout very long, much longer than orbit, 1.47 times as long as orbit and 1.14 times depth of suborbital stay; upper profile of snout straight; snout moderately emarginate, and serrated with fine spines; at angle of each prominence of snout there is a very large spine, the length of which more than half the length of orbit; the distance between their apices much longer than diameter of orbit, about 1.47 times of orbit and equal to the length of snout; interorbital space rather deeply concave, and shorter than diameter of eye,

Fig. 15. *Lepidotrigla kishinouyei* Snyder. ×$\frac{5}{8}$. (Matsubara del.)

about 1.14 in eye; orbit rather small, much shorter than snout or depth of suborbital stay, 1.30 in latter; supraorbital spines small and sharp; post-orbital spines rudimentary; a narrow but deep cross-furrow above posterior margin of eye not meeting medially; parietal ridges small; humeral spine rather long and sharp, $1\frac{1}{4}$ times of eye, and reaching to beneath the sixth dorsal spine; nuchal spine reaches to base of third dorsal spine; maxillary reaching to anterior margin of orbit; developed gill-rakers on first arch 0+6, (including the rudimentary ones 1+14) slender, the second one on lower limb the longest, 4.4 in length of eye.

Second dorsal spine slightly shorter than third dorsal spine, third dorsal spine and those succeeding ones reaching an equal distance posteriorly when fin is depressed; anterior edges of spines serrated, the median row of serrations on the first spine rather strong; first dorsal spine

shorter than fourth spine (about 0.84 of fourth spine); pectoral reaches to base of fourth anal ray; upper detached pectoral ray falling short of tip of ventral by a distance about equal the length of eye; ventral reaches to second anal ray.

Color in formalin dead white, paler below; head and base of caudal fin grayish yellow; inner surface of pectorals dusky above but jet black below, with many white spots, lowermost three rays and detached rays white; other fins white. The full-grown ova are in the ovary.

The foregoing description is drawn from a female specimen from Nagasaki, Imperial Fisheries Institute Mus. No. 15, measuring 186 mm. in total length.

Of about 58 specimens which have come under our examination, four give the following the dimensions:—

TABLE VI.

Specimen No.	1	2	3	4
Locality	China Sea	Nagasaki	Nagasaki	Misaki
Sex	♀	♂	♀	♀
Total length	179.5 mm.	179 mm.	154 mm.	141 mm.
Head in body length	3.36	3.36	3.32	3.33
Depth in body length	4.18	4.40	4.33	4.23
Orbit in head	3.25	3.35	3.35	3.40
Snout in head	2.50	2.65	2.63	2.46
Maxillary in head	2.56	2.6	2.60	2.43
Pectoral in head	0.85	0.84	0.96	0.87
Ventral in head	1.06	1.12	1.09	1.04
Distance between rostral spines in orbit	0.88	0.85	0.70	0.78
Eye in depth of suborbital stay	1.16	1.18	1.22	1.20
Eye in humeral spine	1.11	1.17	1.08	1.10
Depth of candal peduncle in head	5.0	4.8	5.1	4.9
Rostral spine in orbit	2.3	1.27	1.58	3.0

The rostral spine in orbit changes with age and sex. This value is

smaller in male than in female and larger in younger than in older as shown in the preceding table.

A faint blackish blotch is observable on first dorsal of specimens which are less than 140 mm. in length. This blotch extends between fourth and seventh spine and darkens distally. This is entirely absent in larger specimens. However, the number of soft rays of second dorsal is invariably 15 in all our material.

Snyder's (1911, p. 543) original description stands at variance with our material in lacking the black blotch, and in having rostral spine one-third the interorbital space and 13 rays in second dorsal. But these differences appear to be due to age since his specimen measures 98 mm. in length.

This species is readily recognized by the following characters: the rostral spines very long and pungent, at least more than one-third the length of orbit, the distance between their apices very wide, more than 1.4 times of orbit and about equal to the length of snout; inner surface of pectoral grayish with many white spots. Closely related to *Lepidotrigla smithii* Regan, but distinctly differs from it in having the extraordinary long rostral spines.

Fifty specimens from Nagasaki; 5 from China Sea; and 3 from Misaki.

Habitat.—The species seems to be rather common in the seas of southern Japan, especially in the sea of Nagasaki.

Lepidotrigla smithii Regan.

New Japanese Name: Sumisu-kanagasira.

Lepidotrigla smithii Regan, 1905, p. 22.
L. microptera (pars), Jordan and Richardson, 1908, p. 651.

Head 3 in body length; depth about 4; snout 2.5 in head; interorbital space about 4; eye $3\frac{1}{3}$–4. D. VIII or IX–15; A. 14; scales 58–63; scutes on back 23–26.

Head very large; anterior edge of snout slightly emarginated and feebly serrated or entire and with a pair of a short spinous processes, the distance between their apices is equal or a little greater than the diameter of eye; eye very small, much shorter than the depth of suborbital stay; depth of suborbital stay quite deep, nearly equal to the length of snont; no distinct trans-

verse groove behind the orbit; humeral spine subequal to the length of eye maxillary extending to below anterior margin of eye.

Second and third dorsal spines subequal and one-half the length of head; pectoral as long as head, extending to $\frac{1}{3}$ of anal; ventral extending a little beyond origin of anal; upper detached pectoral ray falling short of tip of ventral by a distance about equal to the diameter of eye (from figure).

Olivaceus, with a tinge of pink; a blackish spot on the upper part of spinous dorsal between the fourth and sixth spines; an obscure stripe along the soft dorsal; inner side of pectoral blackish, with small white spots, other fins uniformly pale.

No specimens of this species has come under my examination; the above account is partly copied from the description of Regan (1905, p. 22).

This species is separable from *L. microptera* by the following characters: Second dorsal spine very short, 1.6 in body depth and 1.25 in upper detached pectoral ray; suborbital stay very deep, its depth much longer than eye, 1.64 times of latter and nearly equal to the length of snout; eye very small and body very deep, its depth 4 in body length; number of anal fin 14.

Jordan and Richardson (op. cit. p. 652) say: "There appears to be no doubt that *L. smithii* Regan is the young of this species. Young specimens in our collections from Nagasaki and Wakanoura have D. VIII–15 and A 15. In one of these the first (rudimentary) anal ray is but three-eights of the second, and the second only two-thirds of the third. Regan's figur shows the first spine fully five-sixths of the second, a condition we have not observed in any specimen. As his specimens were all small (7 to 9 cm.) it seems not impossible that he may have overlooked a rudimentary spine. The dark longitudinal bar on the soft dorsal, described by Regan, is a charactaristic of young specimens, appearing in two young individuals $4\frac{1}{2}$ inches long in our collection from Aomori." But our younger specimens of *L. microptera* have larger eye, which is as long as or longer than depth of suborbital stay, snout longer than depth of suborbital stay, and depth in body length more than 4. These characters point to the conclusion that the present species is distinct from *L. microptera*.

Habitat.—Inland Sea of Japan.

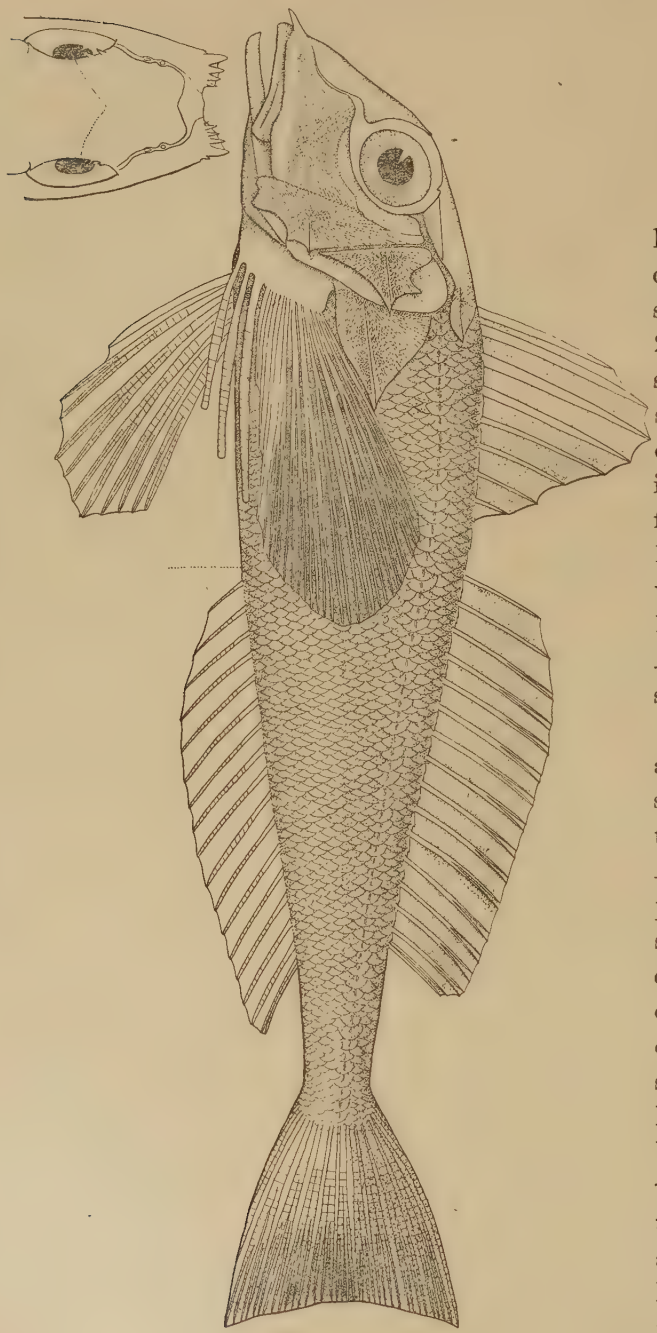


Fig. 16. *Lepidotrigla truncata*, sp. nov. ×$\frac{2}{3}$. (Matsubara del.)

Lepidotrigla truncata, sp. nov.

New Japanese Name: Hanagire-kanagasira.

Head 3.78 in body length; depth 4.42; orbit 3.05 in head; snout 2.9; maxillary 2.52; interorbital space 3; first dorsal spine 1.93; second dorsal spine 1.54; third dorsal spine 1.54; fourth dorsal spine 1.75; pectoral 0.91; ventral 1.05; caudal 1.21; D. VIII–16; A. 17; scales 64; scutes on dorsal 24.

Body rather deep and stout; head somewhat smaller than other species of *Lepidotrigla;* upper profile of snout straight; snout short, equal to the length of orbit; snout truncated at tip and each side armed with four large distinct spines, but the outer one the longest; the distance between their apices equal to the length of eye; interorbital space

shallowly concave, just equal to the length of eye; orbit extremely large, just equal to the length of snout, but much longer than depth of suborbital stay, about 1.2 times of latter; supraorbital spines rather weak; postorbital spine very feeble; an ill-defined cross-furrow above posterior margin of eye not meeting across top of head; parietal ridge entirely wanting; humeral spine long and pungent, 1.1 times of orbit, and reaches to little beyond beneath the fourth dorsal spine; nuchal spine extending to second dorsal spine; maxillary extending to beneath anterior margin of orbit; gill-rakers on first arch 1+8 (including the rudimentary ones 1+15), rather long, the third on lower limb the longest, 3.8 in eye.

Dorsal spines generally short, the second dorsal spine short, equal to third dorsal spine, shorter than longest detached pectoral ray by a distance of one-third the length of eye, and much shorter than depth of body, about 1.31 in depth of body; first dorsal spine much shorter than fourth spine about 0.9 of the latter; the spines not reaching to second dorsal fin when fin is depressed; pectoral extending to base of second anal ray; upper detached pectoral ray falling short of tip of ventral by a distance equal to $\frac{4}{5}$ the length of eye; ventral reaches to vent.

A single specimen preserved in formalin shows a sharp separation of the upper brownish gray part from the lower silvery one; inner side of pectoral dark except lowermost four white rays; first dorsal fin with a indistinct dark mark along the upper margin between fourth and sixth spines, second dorsal fin light gray; caudal yellow at its base, dark gray in the middle portion of the distal part; other fins pale.

Holotype is a male specimen, 259 mm. in total length, from Nagasaki; Imperial Fisheries Institute Mus. No. 16. No other specimen was obtained.

This species is very near to *Lepidotrigla microptera*, but easily distinguishable from it in the following characters: the second dorsal spine very short, equal to the third spine, and much shorter than upper detached pectoral ray or than depth of body, about 1.31 in latter, snout truncated at tip and each side armed with large and distinct four spines; orbit very large, 1.2 times the depth of suborbital stay and equal to length of snout.

Habitat.—Nagasaki.

Lepidotrigla altivelis, sp. nov.

New Japanese Name: Hiredaka-kanagasira.

Head 3.52 in body length; depth of body 4.62; orbit 3.18 in head; snout

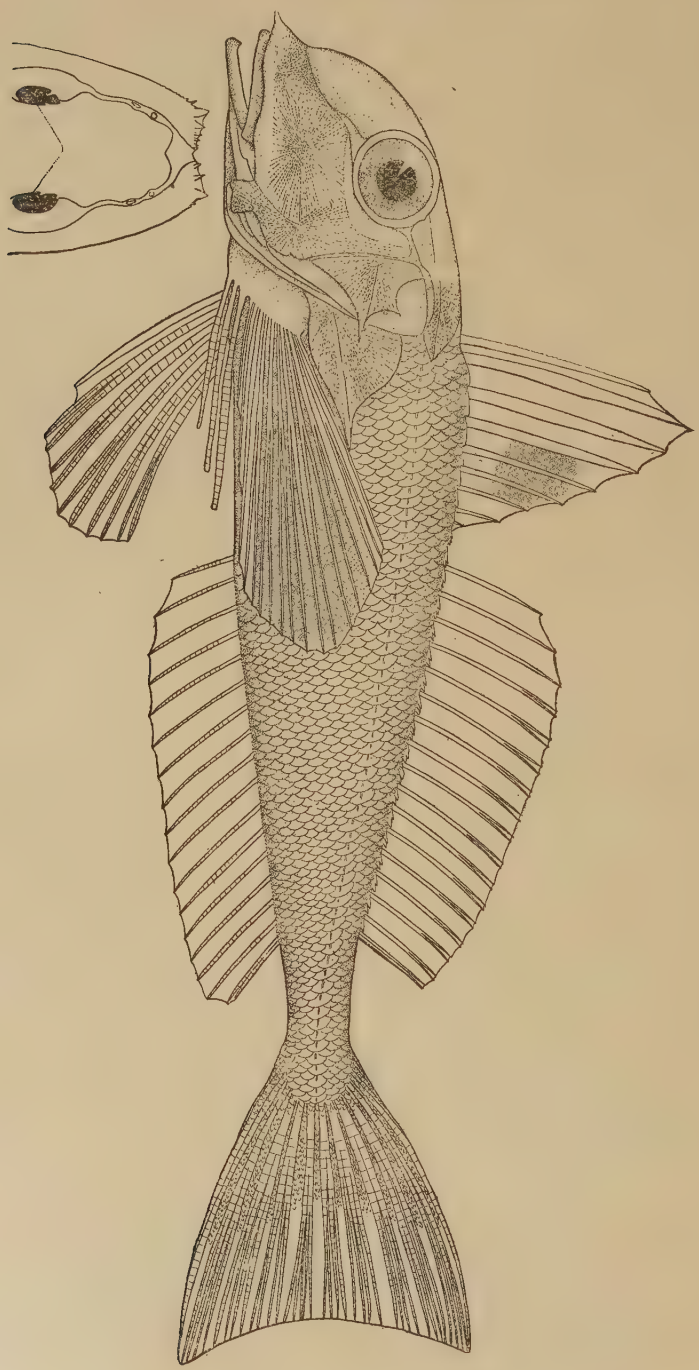


Fig. 17. *Lepidotrigla altivelis*, sp. nov. $\times\frac{2}{3}$. (Matsubara del.)

2.94 ; maxillary 2.57 ; interorbital space 3.50 ; first dorsal spine 1.55 ; second dorsal spine 1.27 ; third dorsal spine 1.42 ; fourth dorsal spine 1.68 ; pectoral 0.95 ; ventral 1.08 ; caudal 1.0 ; depth of caudal peduncle 5.2 ; D. VIII–17 ; A. 17 ; scales 63 ; scutes on dorsal 25.

Body rather slender ; snout shallowly emarginated, with several small spines at each prominence ; the angular spine large, about 4 in eye ; the distance between their apices slightly shorter than eye ; snout rather short, 1.1 times of orbit ; its upper profile evenly convex ; interorbital space shallowly concave, slightly narrower than diameter of eye ; orbit moderate, somewhat shorter than snout and just equal to the depth of suborbital stay ; supraorbital spines rather indistinct ; postorbital spine and a cross-furrow above posterior margin of eye entirely obliterated ; parietal ridge wanting ; humeral spine very long and pungent, 1.26 times of eye, and reaches to beneath fourth dorsal spine ; nuchal spine scarcely extending to third dorsal spine, maxillary extending to little beyond anterior margin of eye-ball ; developed gill-rakers on first arch 0+9 (including the rudimentary ones 1+14), very long and slender, the third one on lower limb the longest, 2.7 in eye.

Dorsal spines very long and broad, the second spine longest, much longer than upper detached pectoral ray, or than third dorsal spine ; slightly longer than depth of body, and reaching to insertion of second dorsal fin when spine is depressed ; third dorsal spine extending to second soft ray ; first dorsal spine slightly longer than fourth spine ; pectoral extending to fourth anal ray ; upper detached pectoral ray falling short of tip of ventral by a distance equal to 0.85 the length of eye ; ventral extends to second anal ray.

Color in formalin uniformly pale brown ; inside of pectoral blackish except upper and lowermost three rays ; first dorsal fin with a distinct blotch between fourth and seventh spines ; other fins pale.

The above description is based upon a male specimen of 264 mm. in total length from Zenra-Nandô, Tyôsen ; Imperial Fisheries Institute Mus. No. 17.

This species is very near to *Lepidotrigla microptera*, but separable from it in the following points : the first dorsal fin very high, especially the second spine very long and stout, longer than depth of body and much longer than upper detached pectoral ray ; the gill-rakers slender, the third one on lower limb the longest, 2.7 in orbit ; and upper profile of snout much convex.

Habitat.—Zenra-Nandô, Tyôsen.

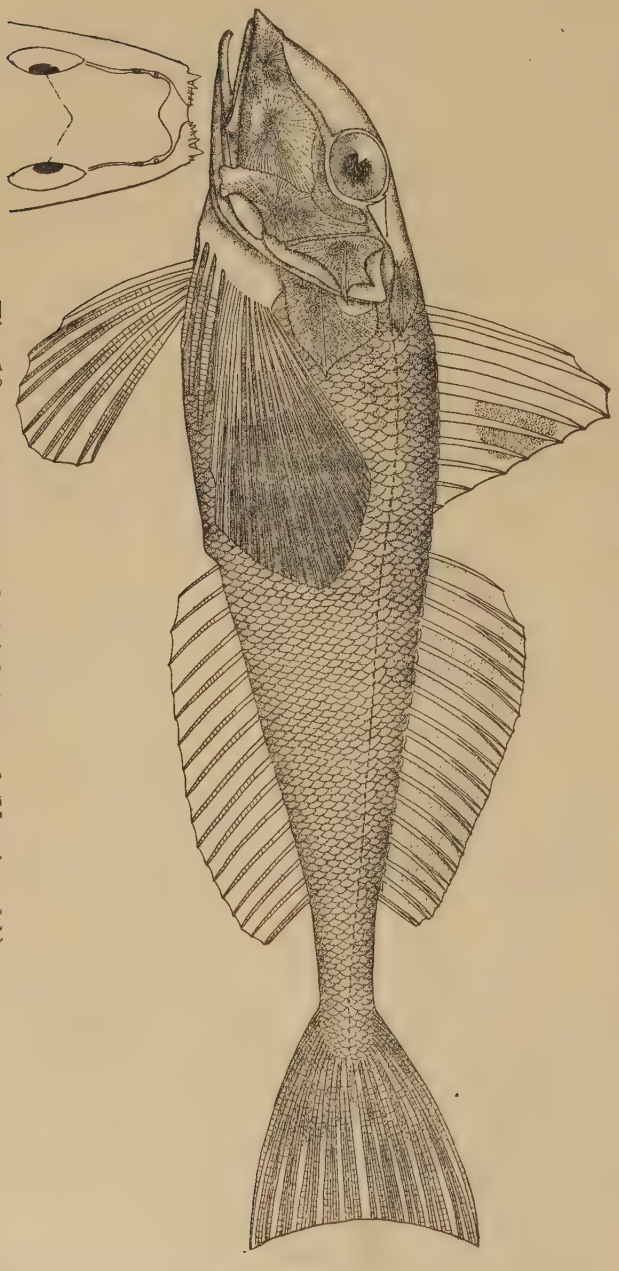


Fig. 18. *Lepidotrigla strauchi* Steindachner. ×½ (Matsubara del.)

Lepidotrigla strauchi Steindachner.

Japanese Name: Iso-kanagasira.

Lepidotrigla strauchi Steindachner, 1876, p. 166 (nec Jordan, Tanaka and Snyder, 1913, p. 291).

Head 3.61 in body length; depth 4.15; orbit 3.8 in head; snout 2.53; maxillary 2.45; interorbital space 3.25; first dorsal spine 1.85; second dorsal spine 1.51; third spine 1.54; fourth spine 1.87; pectoral 0.99; ventral 1.20; caudal 1.40; depth of caudal peduncle 5.4; D. IX–17; A. 17; scales 66; scutes on dorsal 26.

Body deep anteriorly, rather slender posteriorly; head rather small; snout slightly convex in upper profile, much longer than eye, 1.50 times of latter, the anteriorior edge shallowly emarginated, armed with several small spines on each side, its angular spine the largest, the distance between their apices equal to the length of orbit;

interorbital space nearly plain, its width 1.16 times of orbit; orbit small, much shorter than snout and 1.1 in depth of suborbital stay; two rudimentary supraorbital spines and a postorbital spine present; a rudimentary cross-furrow above posterior margin of eye; humeral spine long and pungent, 1.23 times of eye and extending to beneath fourth dorsal spine; nuchal spine reaches to second dorsal spine; maxillary reaching to anterior margin of eye; gill-rakers on first arch 1+8 (including the rudimentary ones 2+17), rather long, but not pointed the second one on lower limb the longest, 3.8 in length of eye.

Dorsal spines very stout; the second spine very slightly longer than the third, equal to the length of upper detached pectoral ray; the first and fourth spines nearly equal in length, the first three spines slightly serrated, the third to sixth spines coterminal when fin is depressed, not reaching to insertion of second dorsal; pectoral extending to second anal ray; the upper detached pectoral ray much shorter than depth of body, about 1.3 in latter and falling short of tip of ventral by a distance equal to 1.3 length of eye; ventral not extending to vent.

Color in formalin dark brown above but paler below as that of *L. brevispinis*, the inner side of pectoral black except lowermost three white rays; first dorsal fin with a dark blotch between fourth to sixth spines; caudal blackish on distal margin except upper and lower portions; other fins pale.

The above description is derived from a female specimen from Genzan, Tyôsen; Imperial fisheries Institute Mus. No. 18, measuring 324 mm. in total length, collected by the staff of the Tyôsen Fisheries Experimental Station.

Other three specimens from Tyôsen differ from the above only in having large value of eye in head as shown in the following table.

TABLE VII.

Locality	Genzan	Yamato-Island	Yamato-Island
Total length	296 mm.	254 mm.	234 mm.
Head in body length	3.86	3.64	3.51
Depth in body length	4.08	4.10	4.17
Orbit in head	3.36	3.31	3.27
Snout in head	2.71	2.64	2.44
Interorbital space in head	2.95	3.15	3.43
Pectoral in head	0.86	0.94	1.00
Ventral in head	1.00	1.13	1.18
Orbit in depth of suborbital stay	1.08	1.03	0.95
Sex	♀	♀	♂

The material at our disposal are in agreement with Steindachner's description except that body is higher in his than ours.

This species is very near to *Lepidotrigla brevispinis* and also to *L. microptera*.

Habitat. — From Tyôsen to Hokkaidô.

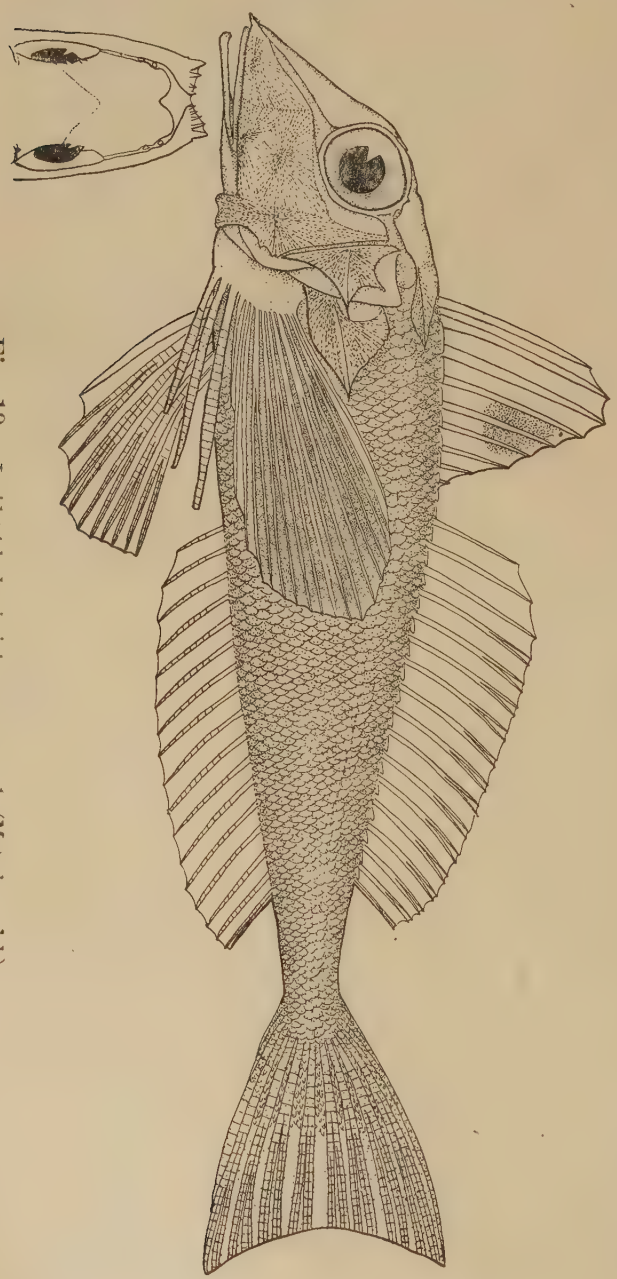


Fig. 19. *Lepidotrigla brevispinis*, sp. nov. ×$\frac{1}{1}$. (Matsubara del.)

Lepidotrigla brevispinis, sp. nov.

New Japanese Name: Isokanagasira-modoki.

Head 3.6 in body length; depth 4.55; orbit 3.14 in head; snout 2.87; maxillary 2.25; interorbital space 3 45; first dorsal spine 1.66; second dorsal spine 1.48; third dorsal spine 1.52; fourth dorsal spine 1.78; pectoral 0.92; ventral 1.10; caudal 1.11; depth of caudal peduncle 4.76; D. IX–17; A. 17; scales 65; scutes on dorsal 25.

Snout relatively short, 1.10 times of orbit; the anterior margin slightly emarginated, each prominence armed with four or five

spines, the angular one the largest, its length 4 in length of eye; the distance between their apices relatively short, 1.23 in diameter of eye; upper profile of snout nearly straight, not convex; interorbital space shallowly concave, its width shorter than diameter of eye, about 1.1 in eye; orbit large, longer than depth of suborbital stay, and slightly shorter than snout; supraorbital spines distinct and rather sharp; a very shallow cross-furrow above the posterior margin of eye, and not crossed medially; postorbital spine absent; a slight ridge on parietal region; humeral spine moderate, extending to under fifth dorsal spine, its length just equal to the length of eye; nuchal spine reaches to third dorsal spine; maxillary extending to benath anterior margin of pupil; gill-rakers on first arch 1+9 (including the rudimentary ones 1+16), slender, and sharply pointed at tip, the third one of the lower limb the longest, 3.4 in length of eye.

First dorsal spine slightly longer than fourth spine; second dorsal spine the longest, shorter than depth of body or than upper detached pectoral ray, about 1.18 in each the third to fifth spines scarcely reaching to origin of second dorsal fin when fin is depressed; first three spines weakly serrated; pectoral long, reaching to sixth anal ray; upper detached pectoral ray falling short of tip of ventral by a distance equal to one-half the length of eye; ventral extending to base of third anal ray.

Color in formalin dark brown, paler below, the inside of pectoral fin blackish except lowermost three white rays; first dorsal fin with a distinct large black blotch between fourth and seventh spines, other fins pale.

Described from a male specimen from Misaki; Imperial Fisheries Institute Mus. No. 19, measuring 165 mm. in total length.

This species is allied to *Lepidotrigla strauchi* Steindachner, but distinct from it in the following characters: the length of orbit large, nearly equal to snout and much longer than depth of suborbital stay; the humeral spine equal to the length of eye, and the ventral fin slightly shorter than head and extends to third anal ray.

Habitat.—Misaki.

Lepidotrigla microptera Günther.

Japanese Name: Kanagasira.

Lepidotrigla microptera Günther, 1873, p. 241, and 1879, p. 67; Steindachner and Döderlein, 1887, p. 263; Jordan and Starks, 1902, p. 595; Jordan and Richardson, 1908, p. 651; Franz, 1910, p. 79; Schmidt, 1931, p. 122.

Lepidotrigla serridens Hilgendorf, 1879, p. 107; Nyström, 1887, p. 21.

Lepidotrigla strauchi (pars) Jordan, Tanaka and Snyder, 1913, p. 291.

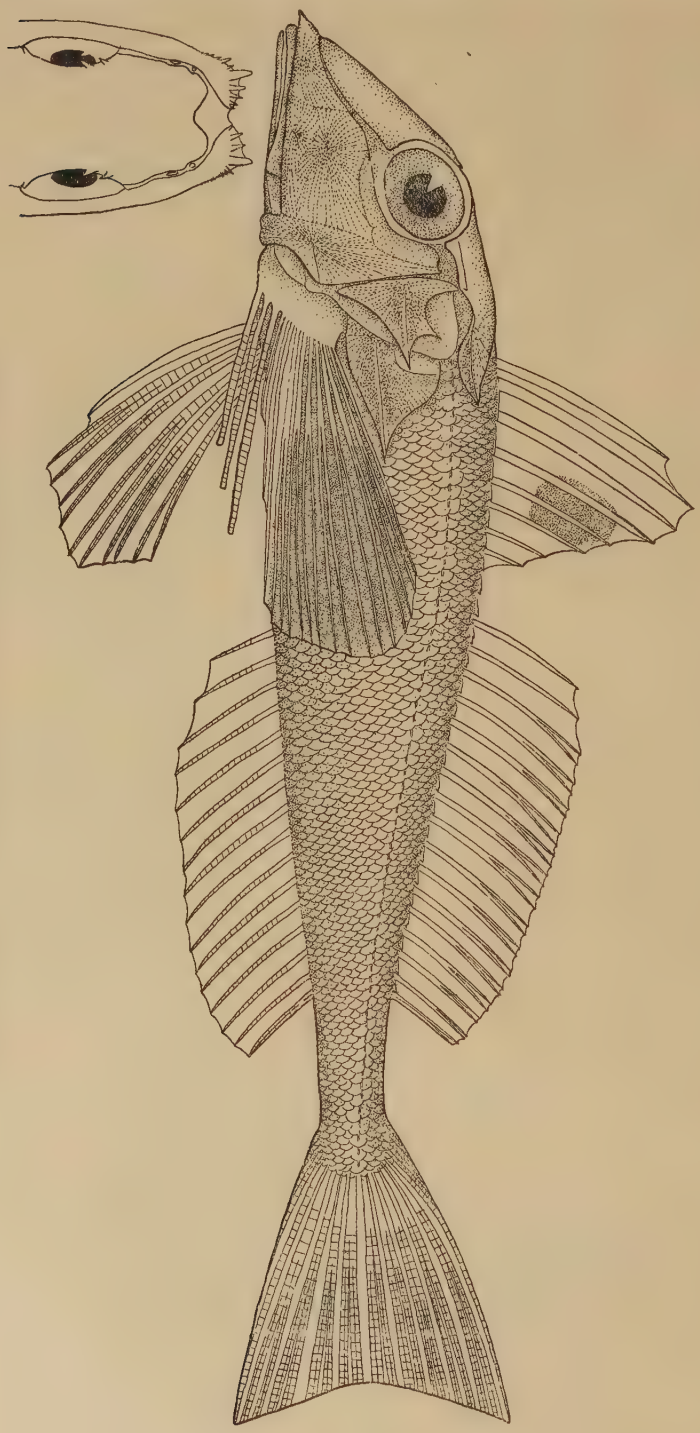


Fig. 20. *Lepidotrigla microptera* Günther, first type. ×⅓. (Matsubara del.)

Head 3.5 in body length; depth 4.9; orbit 3.21 in head; snout 2.79; maxillary 2.32; interorbital space 3.1; first dorsal spine 1.67; second spine 1.4; third spine 1.54; fourth spine 1.76; pectoral 1.03; ventral 1.11; caudal 1.1; depth of caudal peduncle 5.0; D. VIII–17; A. 16; scales 61; scutes on dorsal 25.

Snout comparatively long, much longer than diameter of orbit; the anterior margin of snout shallowly emarginated, armed with several moderate spines, angular one the largest, about 4 in eye; the distance between their apices slightly shorter than eye; upper profile of the snout nearly straight; interorbital space shallowly concave, its width somewhat longer than diameter of eye; orbit moderate, nearly equal to the depth of suborbital stay, and about 1.2 in snout; supraorbital spines sharp and pungent; a very faint cross-furrow above the posterior margin of eye; postorbital spine wanting; humeral spine long and pungent, 1.24 times of eye, and extending to base of fifth dorsal spine; nuchal spine long, reaches to base of third dorsal spine; maxillary extending to little beyond anterior margin of pupil; gill-rakers on first arch 1+7 (including the rudimentary ones 1+13), long and slender, the third one on lower limb the longent, 3.4 in diameter of eye.

Second dorsal spine the longest, nearly equal to the depth of body, and much longer than upper detached pectoral ray; first spine slightly longer than the fourth spine; the second to fifth spines reaching to second dorsal fin when fin is depressed; first to third spines very weakly serrated. Pectoral extending to base of third anal ray; upper detached pectoral ray falling short of tip of ventral by a distance equal to the length of eye; ventral extends to first anal ray.

Color in life brick red above, paler below, fins red; in formalin dark white, paler below; first dorsal fin with a distinct black blotch between fourth to sixth spines; inside of pectoral dark except upper one and lowermost three white rays, but without peculiar marks or spots; other fins pale.

The foregoing description is based upon a male specimen 231 mm. in total length from Nagasaki, collected by trawl; Imperial Fisheries Institute Mus. No. 20.

More than 200 specimens have come under our examination. A greater majority of them leave no doubt as to their specific identity with the holotype of this species. But six of them show remarkable differences from it, and they may be again divided into two types. We were at first inclined to regard the second as a distinct species and the third as a subspecies of the second. Such splitting was abandoned afterwards. Yet it seems advisable to deal with

these types separately so that it will facilitate further analysis of the material. To begin with the measurement of specimens of the first type.

TABLE VIII.

Locality	Tokyo Bay	Tokyo Bay	Tokyo Bay	Misaki	Misaki
Sex	♂	♂	♂	♂	♂
Total length	244.5 mm.	231.0 mm.	209 mm.	233 mm.	248 mm.
Head in length of body	3.55	3.55	3.48	3.67	3.29
Depth in length of body	4.50	4.47	4.54	4.63	5.51
Orbit in head	3.48	3.18	3.08	3.12	3.92
Snout in head	2.66	2.58	2.68	2.95	2.66
Maxillary in head	2.48	2.55	2.44	2.47	2.72
Interorbital space in head	3.45	3.15	3.32	3.19	3.71
First dorsal spine in head	1.71	1.57	1.59	1.76	2.12
Second dorsal spine in head	1.41	1.33	1.58	1.40	1.68
Third dorsal spine in head	1.50	1.43	1.42	1.50	1.63
Fourth dorsal spine in head	1.68	1.60	1.60	1.68	1.87
Pectoral in head	1.00	0.88	0.91	0.89	1.08
Ventral in head	1.12	1.06	1.09	1.11	1.28
Distance between rostral spines in eye	1.24	0.99	1.04	1.13	1.13
Orbit in depth of suborbital stay	1.00	1.01	0.96	0.97	1.12
Orbit in humeral spine	1.40	1.31	1.31	1.34	1.49
Longest detached pectoral ray in depth of body.	0.96	0.92	1.00	1.00	0.95

TABLE IX.

Locality	Misaki	Odawara	Odawara	Odawara	Odawara
Sex	♂	♂	♀	♂	♀
Total length	213 mm.	250 mm.	245.5 mm.	244 mm.	233 mm.
Head in body length	3.83	3.46	3.80	3.73	3.66
Depth in body length	4.41	4.48	4.60	4.71	4.53
Orbit in head	3.24	3.18	3.34	3.33	3.42
Snout in head	2.63	2.72	2.66	2.71	2.60
Maxillary in head	2.34	2.50	2.47	2.43	2.46
Interorbital space in head	3.07	3.24	3.38	3.23	3.53
First dorsal spine in head	1.59	1.84	1.71	1.97	1.80
Second dorsal spine in head	1.32	1.47	1.45	1.50	1.43
Third dorsal spine in head	1.40	1.44	1.49	1.54	1.45
Fourth dorsal spine in head	1.59	1.66	1.72	1.71	1.64
Pectoral in head	0.81	0.95	0.91	0.93	0.92
Ventral in head	0.89	1.12	1.04	1.06	1.08
Distance between rostral spines in eye	1.09	1.19	1.06	1.06	1.02
Orbit in depth of suborbital stay	1.06	0.95	1.00	0.92	1.03
Orbit in humeral spine	1.13	1.26	1.24	1.28	1.14
Longest detached pectoral ray in depth of body.	0.9	0.94	0.85	1.00	0.88

TABLE X.

Locality	Simonoseki	Simonoseki	Simonoseki	Simonoseki	Nagasaki
Sex	♀	♀	♀	♀	♂
Total length	305 mm.	293 mm.	285 mm.	284 mm.	285 mm.
Head in body length	3.70	3.52	3.57	3.54	3.71
Depth in body length	4.90	4.38	4.51	4.73	4.84
Orbit in head	3.65	3.41	3.14	3.61	3.39
Snout in head	2.67	2.70	2.51	2.52	2.53
Maxillary in head	2.40	2.42	2.25	2.52	2.32
Interorbital space in head	3.20	3.09	3.28	3.60	3.48
First dorsal spine in head	1.48	1.81	1.81	2.06	1.82
Second dorsal spine in head	1.47	1.39	1.42	1.53	1.42
Third dorsal spine in head	1.46	1.43	1.48	1.65	1.43
Fourth dorsal spine in head	1.64	1.70	1.73	1.90	1.65
Pectoral in head	1.00	0.99	1.00	0.99	0.98
Ventral in head	1.12	1.12	1.13	1.21	1.08
Distance between rostral spines in eye	0.77	0.85	0.99	1.17	0.92
Orbit in depth of subor-bital stay	1.20	0.96	0.98	1.06	1.08
Orbit in humeral spine	1.47	1.50	1.18	1.13	1.3
Longest detached pectoral ray in depth of body	0.9	0.84	0.84	0.84	0.85

TABLE XI.

Locality	Nagasaki	Nagasaki	Nagasaki	China Sea	China Sea
Sex	♂	♂	♀	♀	♂
Total length	260 mm.	245 mm.	217 mm.	283 mm.	222 mm.
Head in body length	3.39	3.72	3.62	3.74	3.78
Depth in body length	5.30	4.65	5.11	4.90	4.70
Orbit in head	3.25	3.28	3.57	3.35	3.05
Snout in head	2.82	2.84	2.63	2.54	2.72
Maxillary in head	2.30	2.21	2.27	2.32	2.28
Interorbital space in head	3.24	3.15	3.42	2.97	2.87
First dorsal spine in head	1.73	1.70	1.77	1.83	1.58
Second dorsal spine in head	1.48	1.46	1.42	1.48	?
Third dorsal spine in head	1.40	1.53	1.50	1.50	?
Fourth dorsal spine in head	1.68	1.66	1.81	1.60	1.62
Pectoral in head	1.02	0.94	0.94	0.96	0.91
Ventral in head	1.12	1.07	1.12	1.12	1.08
Distance between rostral spines in eye	1.05	0.93	0.87	0.90	1.10
Orbit in depth of suborbital stay	1.00	0.94	1.02	1.10	0.91
Orbit in humeral spine	1.35	1.37	1.26	1.24	1.36
Longest detached pectoral ray in depth of body	1.00	0.90	0.93	0.86	0.94

Table XII.

Depth-variation in *Lepidotrigla microptera* Günther.

Locality	Depth in body length without caudal.													Avarage
	5.55–5.50	5.49–5.40	5.39–5.30	4.29–5.20	5.19–5.10	5.09–5.00	4.99–4.90	4.89–4.80	4.79–4.70	4.69–4.60	4.59–4.50	4.49–4.40	4.39–4.30	
Tokyo Bay		1					1	1		1	4	2		4.70
Misaki	1									1		2		4.74
Odawara									1	2	3	1		4.54
Simonoseki							1		2		3	1	2	4.58
Nagasaki			1	2	1	2	3	3	4	4			1	4.86
China Sea							1		1					4.80
Total	1	1	1	2	1	2	6	4	8	8	10	6	3	4.71

Head-variation in *Lepidotrigla microptera* Günther.

Locality	Head in body length without caudal.							Avarage
	3.89–3.80	3.79–3.70	3.69–3.60	3.59–3.50	3.49–3.40	3.39–3.30	3.29–3.20	
Tokyo Bay	1	1	1	5	2			3.59
Misaki	1		1			1	1	3.54
Odawara	1	2	2	1	1			3.66
Simonoseki		1	3	4		1		3.56
Nagasaki		6	5	7	2	1		3.60
China Sea		2						3.70
Total	3	12	12	17	5	3	1	3.62

As shown in the preceding tables, depth of body gradually decreases as locality ranges from north to south, whereas head in body length varies with the size of specimens. Second dorsal spine is mostly as high as the body, but it is slightly lower than that in northern specimens. Interorbital space is much concave in smaller specimens, but it is flat in larger ones. A black blotch between fourth and sixth spines of first dorsal is usually distinct in younger individuals but obsolete in older ones.

The number of scales on lateral line given as 75 in Günther's (1873, p. 241) original description appears to include that of those on base of caudal fin, since it amounts to 63 to 67 in 40 specimens but to 75 in some ones if those on base of caudal fin are included.

This species, so far defined, is very near to *Lepidotrigla brevispinis*, but easily separable from it in the following characters:

Lepidotrigla microptera	*L. brevispinis*
1. Color brick red in life.	1. ...dark brown.
2. Humeral spine much longer than diameter of orbit.	2. ...equal to or shorter than orbit.
3. The distance between the longest rostral spines subequal to the length of orbit.	3. ...much shorter than orbit, about 1.20 in latter.
4. Orbit rather small, subequal to the depth of suborbital stay and much shorter than length of snout.	4. ...much longer than depth of suborbital stay and nearly equal to the length of snout.

This species is also distinguished from *Lepidotrigla strauchi* in the following characters: the body rather slender, its depth 4.30 to 5.55 in body length; the ventral extends beyond origin of anal; and the body brick red in life, dead white in formalin.

From *L. truncata* this species differs in the following characters: first dorsal fin rather high, the second spine subequal to the depth of body and longer than upper detached pectoral ray; and orbit rather small, subequal or shorter than depth of suborbital stay and snout emarginated with several small spines.

Next follows a description of the second type.

Head 3.6 in body length; depth 4.65; orbit 3.6 in head; snout 2.55; maxillary 2.45; interorbital space 3.4; first dorsal spine 1.80; second spine 1.48; third spine 1.60; fourth spine 1.91; pectoral 1.02; ventral 1.15

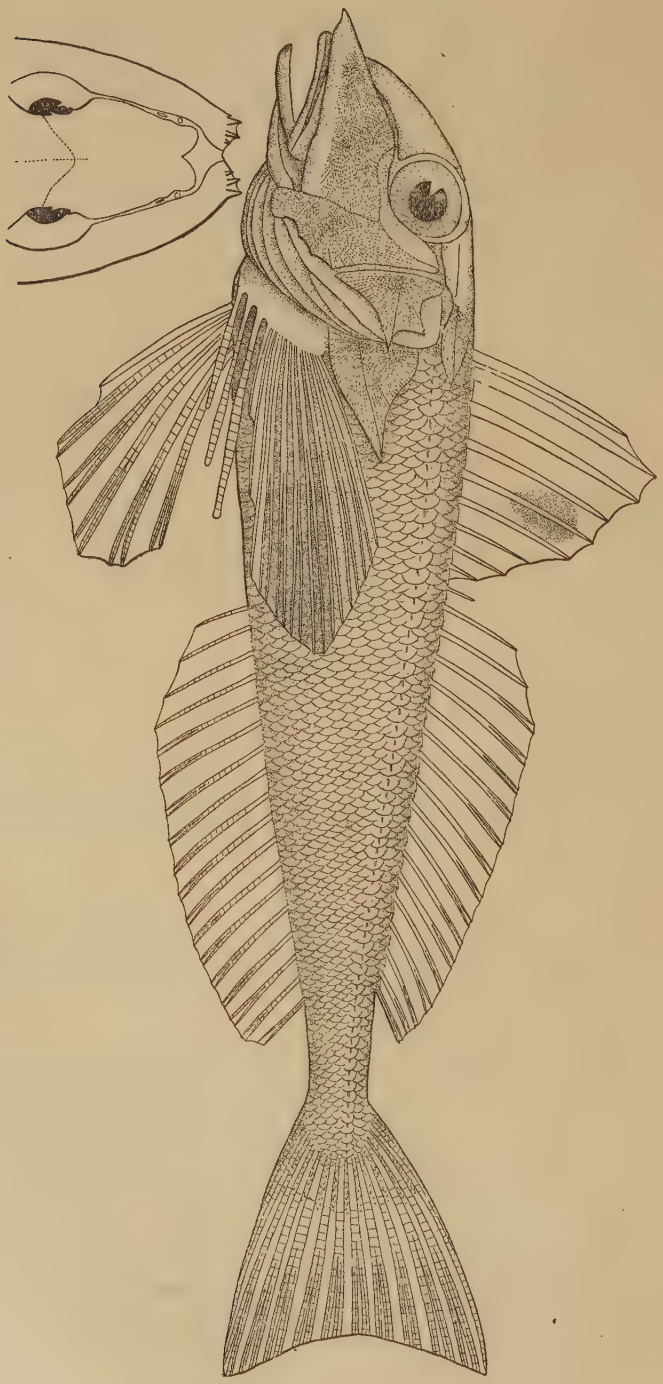


Fig. 21. *Lepidotrigla microptera* Günther, second type. $\times\frac{2}{3}$. (Matsubara del.)

caudal 1.15; depth of caudal peduncle 5.3. D. IX–17; A. 18; scales 64; scutes on dorsal 25.

Body elongate and slender, snout long, much longer than eye (1.5 times of eye), than depth of suborbital stay as well; upper profile of snout greatly convex, snout moderately emarginated, and armed with small several spines only on the lateral prominences, the length of the longest spine about 4.6 in interorbital space; the distance between their apices very short, much shorter than orbit, 1.25 in orbit; interorbital space slightly concave, nearly flattened and slightly longer than diameter of orbit; orbit moderate, equal to the depth of suborbital stay and much shorter than length of snout, 1.5 in snout; supra-orbital spines rather broad and distinct; postorbital spine rudimentary; an impression of cross-furrow present above posterior margin of eye; a slight trace of parietal ridge present; humeral spine long, 1.36 times of eye, and reaches to beneath the fifth dorsal spine; nuchal spine scarcely reaching to third dorsal spine; maxillary extending scarcely to anterior margin of orbit; gill-rakers on first arch 0+8 (including the rudimentary ones 1+15), long and slender, the second one on lower limb the longest, about 3.4 in length of eye.

First dorsal spine slightly longer than the fourth spine; second spine longer than third spine, about 1.1 times of latter; third spine and those of succeeding ones all reach to insertion of second dorsal fin; anterior edges of spines nearly smooth; pectoral reaches to third anal ray; upper detached pectoral ray falling short of tip of ventral by a distance equal to the length of eye; ventral reaches to second anal ray.

Color in formalin dead white; inside of pectoral dusky; first dorsal with a black blotch between fourth and sixth spines; other fins plain.

The above description is based upon a male specimen 266 mm. in total length from Huzan, Korea, got by Dr. Y. Wakiya; Imperial Fisheries Institute Mus. No. 21.

The measurement of four other specimens of this second type is given in the table on next page.

Postorbital furrow disappears as the age advances; it is entirely absent in a female specimen 313 mm. in length. The black blotch on first dorsal is rather persistent, being very distinct in two specimens 178 and 213 mm. long, rather faint in one 266 mm. long, entirely absent in one 313 mm. long.

It is worth mentioning that Schmidt's figure (1931, p. 122) agrees with this second type in having upper profile of snout very convex, and maxillary scarcely extending to anterior margin of orbit.

TABLE XIII.

Locality	Husan	Husan	Husan	Husan
Sex	♀	♂	♀	♂
Total length	313 mm.	235 mm.	230 mm.	178 mm.
Head in body length	3.8	3.4	3.7	3.4
Depth in body length	4.2	4.66	4.58	4.56
Orbit in head	3.4	3.45	3.3	3.35
Snout in head	2.41	2.33	2.53	2.38
Maxillary in head	2.35	2.55	2.45	2.55
Interorbital space in head	3.1	3.25	3.17	3.5
First dorsal spine in head	1.77	1.99	1.62	1.90
Second dorsal spine in head	1.50	1.80	1.27	1.48
Third dorsal spine in head	1.55	1.75	1.29	1.48
Distance between rostral spine in orbit	1.08	1.05	1.44	1.20
Orbit in depth of suborbital stay	1.04	0.94	1.27	1.01
Depth of caudal peduncle in head	5.0	6.1	5.15	5.25

This type can be distinguished from the first type of *Lepidotrigla microptera* in the following characters: the distance between apices of longest rostral spine very narrow, much narrower than length of eye, and the upper profile of snout is very convex even in small specimens.

One specimen collected from the same locality as the above specimens is referred to the third type which is characterized by the following features: the third dorsal spine much longer than second spine and the eye slightly shorter than depth of suborbital stay and the upper detached pectoral ray falling short of tip of ventral by a distance about equal to 1.22 the length of eye.

Fig. 22. *Lepidotrigla microptera* Günther, third type. ×⅔. (Matsubara del.)

Bibliography.

Bleeker, P. 1857. Niewe nalezingen op de ichthyologie van Japan. Verhandl. Batav. Genootsch., **26**.

Bleeker, P. 1879. Enumération des espèces de poissons actuellement connues du Japon. Versl. Meded. Akad. Afd. Nat., **18**.

Cuvier, G. et Valenciennes, A. 1830. Histoire naturelle des poissons, **4**.

Day, F. 1889. Fauna of British India, **2**.

Franz, V. 1910. Die Japanische Knochenfische der Sammulungen Haberer und Doflein. Abhand. math-phys. Klas. K. Bay. Akad. Wiss., **4**.

Günther, A. 1860. Cat. Fish. Brit. Mus., **2**.

Günther, A. 1873. Report on a collection of fishes from China. Ann. Mag. Nat. Hist., ser. 4, **12**.

Günther, A. 1879. Report on the shore fishes. Challenger Report, **1**.

Hilgendorf, F. 1879. Einige Beiträge zur Ichthyologie Japans. Sitzber. Ges. Naturf. Freunde Berlin, 105–111.

Houttuyn, M. 1782. Beschrijving van eenige Japansche visschen en andere Zeeschepselen. Verh. Holl. Maatsch. Wet. Haarlem, 20.

Ishikawa, C. and Matsuura, K. 1897. Preliminary catalogue of fishes, including Dipnoi, Cyclostomi and Cephalochorda, in the collection of the natural history department, Imperial Museum. Tokyo.

Jenyns, L. 1842. Fish (In the zoology of the voyage of H. M. S. "Beagle," during the years 1832–1836; edited by Charles Darwin, pt. 4).

Jordan, D. S. and Hubbs, C. L. 1925. Record of fishes obtained in Japan, 1922. Mem. Car. Mus., **10** (2).

Jordan, D. S. and Richardson, R. E. 1908. A review of the flat-head, gurnards, and the other mail-cheeked fishes of the waters of Japan. Proc. U. S. Nat. Mus., **33** (1581).

Jordan, D. S. and Starks, E. C. 1902. List of fishes dredged by "Albatross" off the coast of Japan in 1900. Bull. U. S. Fish. Comm., **20**.

Jordan, D. S. and Starks, E. C. 1907. Note on Otohime, new genus of gurnards. Proc. U. S. Nat. Mus., **32**.

Jordan, D. S. and Thompson, W. F. 1914. Record of the fishes obtained in Japan in 1911. Mem. Car. Mus., **6**.

Jordan, D. S., Tanaka, S., and Snyder, J. O. 1913. A catalogue of the fishes of Japan. Jour. Coll. Sci., Tokyo Imp. Univ. **33** (7).

Kaup, J. J. 1858. Einiges über die Acanthopterygiens à jouve cuirasée Cuv. Arch. Naturgesch. **22** (1).

Kaup, J. J. 1873. Über die Familie Triglidae nebst einigen Worten über die Classification. Archiv. für Naturgech.

Lesson, R. P. and Garnot, 1830. Poissons. Voyage authour du monde, exécuté par ordre du roi, sur la corvette de sa majesté, "La Coquille," pendent les années 1822, 1823, 1824 et 1825, sous le ministère et conformément aux instructions de s. e. m. le marquis de Clermont-Tonnerre, ministre de la marine, Zoologie, **2** (1) Paris.

McClelland, J. 1844. Description of a collection of fishes made at Chusan and Ningpo in China, by G. R. Playfair. Journ. Nat. Hist. Calcutta. **4**.

Nyström, E. 1887. Redogörelse för den Japaniska Fishamlingen i Upsala Universitates Zoologiska Museum. Bihang till K. Svensk. Vet-Akad. Handl., Band 13 (4).

Regan, C. T. 1905. On the collection of the fishes from the Inland Sea of Japan. Ann. Mag. Nat. Hist., Ser. 7 (15).

Ditto. 1907. Report on the marine fishes collected by Mr. J. Stanley Gardiner in the Indian Ocean. Trans. Linn. Soc. London. **12**.

Richardson, J. 1839. Description of fishes collected at Port Arthur in Van Diemen's land. Proc. Zool. Soc. London. **7**.

Richardson, J. 1845. Report on the ichthyology of the seas of China and Japan. Rept. Brit. Assoc. Adv. Sci., **15**. meet.

Schmidt, P. J. 1931. Fishes of Japan collected in 1901. Trans. Pacif. Comm. Acad. Sci. U. S. S. R. **2**.

Snyder, J. O. 1911. Descriptions of new genera and species of fishes from Japan and Riu-kiu Island. Proc. U. S. Nat. Mus., **40** (1836).

Steindachner, F. and Döderlein, L. 1887. Beiträge zur Kenntnis der Fische Japans. Denksch. Kais. Akad. Wiss. **4**.

Steindachner, F. 1876. Ichthyologische Beiträge. Sitzungsbar. Akad. Wiss. Wien. **5**.

Tanaka, S. 1914. Figures and descriptions of the fishes of Japan, **15**.

Temminck, C. J. and Schlegel, H. 1850. Siebold's Fauna Japonica, Pisces.

On the Separation of Glycerides of Tuna (*Thynnus* sp.) Oil.

Ikunosuke Okada.

(Received November 5th, 1932.)

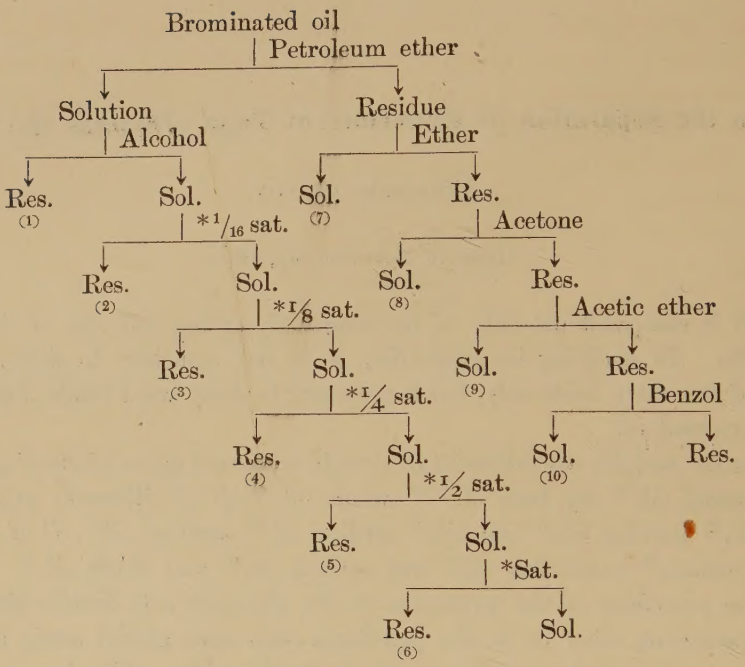
Oil is composed not only of the simple glycerides, but also of the mixed glycerides. In studying its properties, it is not sufficient to determine the kinds of the fatty acids only, but is necessary to study what kinds of glycerides is it composed of.

Suzuki and his coworkers have already separated many kinds of glycerides from linseed oil,[1] soy bean oil,[1][3] whale oil,[1] oil of silkworm pupa[2], cod liver oil,[2] herring oil,[3] cod oil,[3] sardine oil,[3] sand eel oil[3], oil of *Theragra charcogramma*,[3] cuttle fish oil,[3] red salmon oil,[3] and shark oil.[3]

The procedure of the separation of the glyceride is to dissolve the neutral oil in petroleum ether or in the petroleum ether with glacial acetic acid, add bromine to it and to precipitate its bromoglycerides while kept cool continuously. The method is extensively used as hexabromide test. Levene and Rolf[4] used this method when they made the separation of constituents of soy bean lecithin, and they made the separation of glycerides from bromide by the fractional precipitation. But Suzuki and his coworkers, considering this method unsatisfactory, deviced the new procedure of the separation of the glycerides by utilizing the different solubilities of the brominated oil against several organic solvents. In this method many solvents are used one after the other, but it is not yet determined in what order are they used theoretically and what sorts of glycerides are soluble in what solvent.

The author separated bromoglyceride from tuna oil, in accordance to the procedure which he had already reported.

The outline of procedure as well as the glycerides separated are shown in the following tables.



* Saturated alcoholic solution of calcium chloride.

		state	M.P.
1.	Tricetrein bromide	oil	
2.	Stearo-dicetrein bromide	oil	
*3.	Palmito-dicetrein bromide	oil	
*4.	Palmito-dicetrein bromide	oil	
5.	Dipalmito-zoomarin bromide	oil	
6.	Dipalmito-cetrein bromide	oil	
7.	Palmito-($C_{18}H_{27}OBr_8$)-linolenin bromide		85°C
8.	($C_{22}H_{37}OBr_6$)-diarachidonin bromide		110°C
9.	Cetreo-linoleno-arachidonin bromide		105°C

* Isomeric to each other.

EXPERIMENTAL.

1. Tricetrein bromide. When alcohol was added to a petroleum ether solution of brominated oil, two layers appeared. The upper ethereal solution which was taken out, evaporated to dryness, and the residue was washed

throughly with alcohol until Br-content remained constant. It was an oily substance. Br : 31.20% (Calc. 31.30). On hydrolysing the glyceride with HCl, dibromobehenic acid (an oil Br : 31.95%) to the amount of 87% of the theory was obtained.

2. Stearo-dicetrein bromide. When the liquid part of the brominated glycerides which was soluble in alcohol was treated with a 1/16 saturated alcoholic solution of $CaCl_2$ an oily substance was obtained which was insoluble in the latter solvent. Br : 24.10% (Calc. 24.25). On hydrolysing the glyceride with HCl, stearic acid (m.p. 69°C.) and dibromobehenic acid (an oil Br : 31.97%) were obtained. The molar ratio of the two acids was about 1 : 2.

3. Palmito-dicetrein bromide. When the part soluble in a 1/16 saturated alcoholic solution of $CaCl_2$, was treated with a 1/8 saturated alcoholic solution of $CaCl_2$, an oily substance insoluble in the latter solvent was obtained. Br : 24.58% (Calc. 24.76). On hydrolysing the glyceride with HCl, palmitic acid (m.p. 62°C.) and dibromobehenic acid were obtained. The molar ratio of the two acids was about 1 : 2.

4. Palmito-dicetrein bromide. When the part soluble in a 1/8 saturated alcoholic solution of $CaCl_2$ was treated with a 1/4 saturated alcoholic solution of $CaCl_2$, an oily substance again was obtained. Br : 24.50% (Calc. 24.76). On hydrolysing the glyceride with HCl, palmitic acid (m.p. 62°C.) and dibromobehenic acid were obtained in molar ratio of about 1 : 2.

5. Dipalmito-zoomarin bromide. When the part soluble in a 1/4 saturated alcoholic solution of $CaCl_2$, was treated with a 1/2 saturated alcoholic solution of $CaCl_2$, an oily substance was obtained. Br : 16.59% (Calc. 16.56). On hydrolysing the glyceride with HCl, palmitic acid (m.p. 62°C.) and dibromopalmitic acid were obtained in molar ratio of about 2 : 1.

6. Dipalmito-cetrein bromide. When the part soluble in a 1/2 saturated alcoholic solution of $CaCl_2$, was treated with a saturated alcoholic solution of $CaCl_2$, an oily substance was obtained. Br : 15.05% (Calc. 15.24). On hydrolysing the glyceride with HCl, palmitic acid (m.p. 62°C.) and dibromobehenic acid were obtained in molar ratio of about 2 : 1.

7. Palmito-($C_{18}H_{27}OBr_8$)-linolenin bromide. It was soluble in ether but insoluble in petroleum ether. It was purified by repeated precipitation from ether. M.p. : 85°C., Br : 56.76% (Calc. 56.40). The glyceride was hydrolysed with HCl, palmitic acid (m.p. 62°C.) and hexabromo-stearic acid (m.p. 178°C., Br : 63.10% (Calc. 63.27)) and $C_{18}H_{28}O_2Br_8$ (m.p. 105°C., Br : 69.55% (Calc. 69.82)) were obtained in molar ratios of 1 : 1.13 : 1.37.

8. ($C_{22}H_{37}OBr_6$)-diarachidonin bromide. It was obtained by treating the residue of (7) with acetone. It was purified by precipitating several times from the solvent. M.p.: 110°C., Br: 65.25% (Calc. 65.49). On hydrolysing the glyceride with HCl, $C_{22}H_{38}O_2Br_6$ (m.p. 85°C. Br: 58.80% (Calc. 58.91)) and octabromoarachidic acid (m.p. 220°C. Br: 67.50% (Calc. 67.75)) were obtained in molar ratio of 1 : 2.10.

9. Cetreo-linoleno-arachidonin bromide. The residue of (8) which was treated with acetic ether, was purified by precipitating repeatedly from the same solvent. On hydrolysing with HCl, dibromobehenic acid (Br: 32.01%), hexabromostearic acid (m.p. 178°C., Br: 63.10%) and octabromoarachidic acid (m.p. 220°C., Br: 67.52%) were obtained in molar ratios of 1 : 1.01 : 1.11.

10. The residue of (9) was treated with benzol. This part was so small in quantity that its further study could not be carried out.

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References.

(1) Suzuki and Yokoyama :—J. Agr. Chem. Soc. of Japan (in Japanese) Vol. 3. No. 11. 1928.
Suzuki, Masuda :— „ „
(2) Suzuki, Masuda :— „ Vol. 4. No. 7. 1929.
Suzuki, Yokoyama :— „ „
(3) Suzuki, Masuda :—Proceedings of the Imperial Academy. Kyoto Imp. Univ. Vol. 5. No. 7. 1929.
Suzuki, Nishiyama, Masuda :— „ „
Suzuki, Masuda, Shinozaki :— „ „
Suzuki, Masuda, Shinozaki, Nishiyama :— „
Suzuki, Nishimoto :— „ „
Suzuki, C. Wilson :— „ „
Suzuki, Tachibana :— „ „
Suzuki, Okada :— „ „
Suzuki, Yoshida :— „ „
(4) Levene and Rolf :—J. Biol. Chem. 65. 1925.